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# THE AMERICAN REVIEW OF TUBERCULOSIS

JOURNAL OF

THE NATIONAL ASSOCIATION FOR THE STUDY AND PREVENTION OF TUBERCULOSIS

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# TUBERCULOSIS THESES

## DIAGNOSTIC, PROGNOSTIC, THERAPEUTIC

LAWRASON BROWN
*Saranac Lake, New York*

Articles of faith to which one may subscribe or from which one may dissent are of value in many activities of life. To the beginner in an art they point out a ford across troublous and swift waters. That other easier and safer fords are not to be found or indeed do not already exist is not denied, but here at least is one. To him who has long practised the art they seem, in part at least, axiomatic and tiresome, or else not to be accepted. Their power to arouse discussion among these, to lead to thought, to foster healthy disagreement, is all that their author desires for them.

That he will be able to subscribe to them all in some months he doubts, but today they represent what he finds from his experience, colored no doubt by that of many men, serve as his guide for action.

Hippocrates wrote many aphorisms and Gee's clinical aphorisms are well known. Succinct and concise always, they are often clear. For these reasons a friend reads them in order, if possible, to uphold and to praise them and an enemy to seize upon a welcomed opportunity to refute his antagonist.

The Diagnostic Theses have appeared in part elsewhere (1). In their present form these theses were used as the summary of a course of lectures given by the writer.

### I. DIAGNOSTIC THESES

1. An appearance of ruddy health does not exclude tuberculosis.

2. In any patient with constitutional symptoms, no matter of what he complains, the possibility of tuberculosis must be kept constantly in mind.

3. Prolonged and intimate exposure at any time of life, but especially in childhood, and in home or workshop or office, is vastly more important in diagnosis than "unassociated" or "non-contact" heredity.

4. Prolonged contact with tuberculosis may lead to infection, but debilitating conditions are usually necessary to cause this to develop into clinical tuberculosis.

5. Constitutional or general symptoms lead toward the diagnosis of tuberculosis, while the localizing symptoms point out the organs involved.

6. The history or presence of certain complications, as fistula in ano, pleurisy, adenitis, a discharging ear coming on painlessly, are all strongly suggestive of tuberculosis.

7. Pleurisy with effusion, not attributable to other causes, should be treated for a time as due to tuberculosis.

8. Loss of color, prolonged exposure to tuberculous infection, especially in childhood, with a history of swollen glands at that time, the more recent subjection to debilitating conditions, the presence of unequivocal constitutional and localizing symptoms, with or without the aforementioned complications, demand a diagnosis of pulmonary tuberculosis even though no abnormal physical signs are present in the lungs.

9. A diagnosis, tentative at least, must be made whenever an individual spits a dram or more of blood that cannot be proved to be due to other causes (e.g., mitral stenosis).

10. *Your* patients, *your* friends, *your* family are as prone to contract and develop pulmonary tuberculosis as hundreds of others.

11. Symptoms indicate that a patient is sick, while physical signs point out only the mischief that has been done.

12. Symptoms are a better and more accurate guide to activity than are physical signs.

13. Symptoms without physical signs demand treatment, while physical signs without symptoms require often only careful watching.

14. Slight but persistent rise in temperature and increase in rapidity of pulse are often present early in the disease.

15. The usual weight of a patient who develops pulmonary tuberculosis is often ten pounds below the normal weight for his height and age.

16. Failure to interpret rightly the significance of symptoms, to detect the presence of abnormal physical signs, can be condoned; but

failure to ask for and to examine the sputum repeatedly in any patient with chronic cough is inexcusable.

17. Absence of tubercle bacilli in the sputum means only that bronchial ulceration has not occurred.

18. The importance of physical examination in the diagnosis of pulmonary tuberculosis has been overemphasized.

19. No single physical sign is pathognomonic of pulmonary tuberculosis.

20. Auscultation and inspection are the most important procedures in the detection of abnormal physical signs.

21. Inspection reveals localized retraction of the chest wall and limitations of the chest movement.

22. Auscultation is more important than inspection, and the detection of râles by the auscultation of the inspiration following cough is the most important procedure in the detection of physical signs of early pulmonary tuberculosis.

23. Localized râles are second in importance only to tubercle bacilli in the sputum.

24. Râles at an apex may be due to apical pulmonary collapse, chronic bronchitis, a clearing acute bronchitis, or localized pulmonary oedema.

25. Changes in the relative lengths, quality and intensity of the inspiration and expiration are valuable but less easy to deceit.

26. Kronig's tone planes, Goldscheider's method of percussion and Riviere's bands of impairment, as well as palpatation of muscle spasm, have not proved of great value.

27. Measurements of variations in the vital capacity of the lungs are of little benefit and possibly of harm in early pulmonary tuberculosis.

28. The importance of any physical sign is greatly increased by its persistence in one definite area.

29. The disease is practically always more extensive than the physical signs indicate.

30. Abnormal physical signs in one apex should be considered as due to pulmonary tuberculosis until proved not to be, while those at the base should be looked on as non-tuberculous until definitely proved so.

31. Abnormal physical signs should not be stated to be absent until after a second examination.

32. The fluoroscope, the Roentgenogram and particularly stereograms may reveal and locate pathological pulmonary changes to be detected by no other means.

33. Extensive "peribronchial" changes in stereograms may occur with slight or no physical signs, while parenchymatous changes are usually accompanied by abnormal pulmonary sounds.

34. X-Ray plates are of value only when taken and interpreted by experts.

35. Laryngeal infiltration or ulceration, limited to one side in any patient with doubtful pulmonary findings, is suggestive evidence of the presence of pulmonary tuberculosis.

36. When sputum is lacking, or when tubercle bacilli are absent on repeated examination, the possibility of the presence of bronchiectasis, hyperthyroidism, syphilis and influenza; and more rarely pulmonary tumor and Hodgkin's disease, should be borne in mind.

37. Endocarditis, sinus infections and pyorrhoea alveolaris have misled good men.

38. Sero-diagnosis apart from complement fixation has afforded little help in diagnosis.

39. No modification of the tuberculin tests as yet devised differentiates clearly clinical tuberculosis that demands vigorous treatment from non-clinical tuberculosis that requires only a God-fearing life.

40. It may be impossible to determine definitely the presence or absence of clinical tuberculosis.

## II. PROGNOSTIC THESES

1. The uncertainties of prognosis decrease rapidly after the first year of disease but are ever present.

2. He who promises a patient what is unattainable injures himself more than the patient.

3. He is most dogmatic who verifies least often his prognosis. Dogmatism and brief observation are boon companions.

4. Recovery in pulmonary tuberculosis, like recovery in carcinoma, can occur in the apparently hopeless, but does occur very rarely.

5. Whether physician or patient, he, who is deceived by the "false convalescence" of Laennec, justifies the use of this term.

6. Whoever suffers relapse from unavoidable adverse conditions does better than he who relapses without discoverable cause.

7. The prognostic significance of race depends more upon the habits of the individuals than upon other racial characteristics.

8. Resistance to clinical disease, absent up to the fourth month of life, increases from the first year on, and from about the sixth to the fourteenth year is better than in adult life. It may persist into old age when, however, the recuperative powers are at a low ebb.

9. Lack of self-restraint is no great bar to recovery before the fifteenth year, but lack of self-restraint after this age often spells death.

10. Puberty and menopause have less bearing upon the disease than pregnancy, especially repeated, frequent pregnancies, and hence marriage for woman increases the uncertainties.

11. Tuberculous parents (when the child is under two or three years of age) increase incalculably the chance of infection. Hence the importance of exposure to family infection has often been transferred to inheritance, which beyond this exerts no definitely proven influence.

12. The mentality and characteristics of the patient's family, their ability and willingness to help in his recovery by self-sacrifice over long periods of time, are most important. Therefore, recovery in the midst of the family is the most favorable recovery.

13. Poverty snatches recovery from the grasp of many a patient but money is only an adjuvant, not a means, to cure.

14. He who has worked indoors does better, *ceteris paribus*, than he who has always seen the light of the sun in God's fresh air.

15. He works longest who works easiest, that is, he, who returns to his former occupation when congenial and not complicated by sudden great effort and so makes his living with least exertion and worry, avoids relapse most often.

16. Recovery in a climate in which a patient is to live, especially if accomplished at home, bespeaks greater longevity than immediate change of climate on arrest of disease. Climate may be only a minor factor in this effect.

17. He, who is methodical and not lethargic, cheerful and not over sanguine, firm and not stubborn, educated about relapse and not ignorant of nor indifferent to others' mistakes and failures, self-reliant and not selfish, possessed of imagination and of self control in the worship of Bacchus, Venus, and Mercury grasps easily and surely his problem and solves it more successfully.

18. A sudden onset with acute symptoms bespeaks an earlier diagnosis than an insidious or catarrhal onset and hence treatment is begun earlier and life is more often prolonged.

19. An acute onset with extensive physical signs or with severe and protracted symptoms points to a prolonged illness or an early fatal termination.

20. Complications, particularly when tuberculous, are always to be dreaded.

21. The consumption of the body, with or without fever, indicates that assimilation is failing and when steady and continuous is *a priori* evidence of poisoning of the body cells, betokening a serious outcome.

22. The continuous gain of weight on an ordinary diet is the best indication of favorable progress but can occur with advancing disease.

23. Assimilation depends primarily upon ingestion, and "poor eaters," with strong antipathies to milk, eggs and meat, do badly.

24. Digestion is the keystone of the prognostic arch.

25. A continuous flux of the bowels with irregular temperature, tender points in the abdomen and pain on eating, points to a fatal outcome.

26. Fever is the best sign of progressive disease and its chances of disappearance are inversely proportional to the length of time it has persisted.

27. Persistent high temperature under appropriate treatment, with slight physical signs, is grave.

28. Frequent, recurring febrile attacks indicate advancing disease.

29. A low temperature when other things are favorable is of little moment, especially in cold climates.

30. The pulse rate, together with the temperature and weight, forms the prognostic triad.

31. A pulse constantly over one hundred when the patient is at rest in bed is of bad omen when not due to digestive disturbances.

32. Haemoptysis as an accident in the course of the disease is of little moment but when accompanied with fever, cyanosis, dyspnoea or tachycardia, is most grave. It is a favorable sign only when at onset it fills the patient with the fear of God and a determination to obey orders.

33. The patient's mental attitude is of nearly equal importance to his physical reaction to his disease.

34. Nervousness that leads to marked dyspepsia or to excessive fear leads also toward the grave.

35. Dyspnoea may be the only pronounced symptom of acute miliary tuberculosis of the lungs.

36. Uncontrollable excessive cough is the worst form of overexercise and favors a quick deterioration of the bodily resistance.

37. Loss of menses indicates a weakening of the vital forces; a return of them an increase.

38. No urine or serum test is of prognostic value in incipient or moderately advanced stages, but at times the urochromogen or diazo reaction may afford some aid in far advanced stages.

39. Arneth's polymorphonuclear picture has helped some workers.

40. A positive skin test under the age of two indicates often an active tuberculosis. In youth, adult life and old age, no tuberculin test distinguishes clearly and surely active from arrested disease.

41. Physical signs tell by inference what has happened in the lungs, symptoms what is happening. The general condition is more important than the physical signs or the history.

42. The most certain thing about the physical signs of "activity" or "softening" is their uncertainty.

43. Disease at an apex usually heals better than disease located elsewhere.

44. Extent of disease marks the time element; intensity the acuteness.

45. Extent of disease postpones arrest longer than localized intensity.

46. Extensive disease with short duration or scattered foci of the same age occurring early in disease betoken lack of resistance.

47. Granting the diagnosis, slight deviations in breathing or percussion are the most favorable physical signs.

48. The condition of the opposite side in advanced disease affects seriously the prognosis.

49. Increase of physical signs with marked lessening of localizing and general symptoms and gain in weight, does not necessarily indicate an advance of disease.

50. Improvement and even arrest may occur without change in physical signs.

51. The greater the quantity and possibly the greater the fluidity of sputum, when persistent, the less favorable the prognosis.

52. Tubercle bacilli in the sputum indicate bronchial ulceration and the larger the number possibly the greater or more acute the ulceration, but enormous masses may occur in favorable cases.

53. The arrangement of the tubercle bacilli in clumps, chains, parallel pairs, or their occurrence in phagocytes is of uncertain prognostic moment.

54. Tuberculous laryngitis, when in the form of slight swelling in the posterior interarytenoid space or slight ulceration of a cord without dysphagia, in a sensible, tractable patient, aggravates the pulmonary prognosis but little.

55. Pneumothorax or tuberculous enteritis is always serious and usually ushers in a fatal stage of the disease.

56. Duration of treatment of less than three months is of little permanent help, while three or four years of treatment may complete an arrest.

### III. THERAPEUTIC THESES

1. The tendency to recovery in some patients is so marked that it ensues in spite of the most injurious treatment.

2. There is no disease for which the medical profession can do so little actively as for steadily advancing pulmonary tuberculosis.

3. The treatment of pulmonary tuberculosis demands little knowledge of drugs but much about the immediate and prolonged education of the patient.

4. Whatever advantages the sanatorium and the class system and certain physicians possess, and they are many, lie in the fact that these institutions are really teaching institutions and the physicians are educators.

5. The marked tendency to temporary arrest or quiescence even in advanced stages rests upon the brow of the tuberculous evil doer like the curse of Cain.

6. The danger time in tuberculosis, the perils of the "false convalescence" of Laennec, cannot be overemphasized.

7. The idea that pulmonary tuberculosis is a most curable disease is a fallacy.

8. The time allotted to treatment is usually too short, for recovery is ever longer than onset. The value (possibly the results) of treatment increases as the square of the time, that is, two years are four times as valuable as one, *but* the struggle lasts often from diagnosis till death.

9. The physician must always bear in mind that he can influence the lungs only through the medium of the body. Hence besides being an educator he must become an expert in physical training.

10. The physician must have imagination, sympathy, firmness, approachableness, as well as knowledge of the disease of the individual patient, his psychological and his sociological condition, and last but not least, of the limitations of *his* own knowledge.

11. The patient is worried, confused, twists what is told him and can master the thousand and one details only by repeated perusals of directions carefully written down. He should not be blamed for the physician's mistakes of omission. Word of mouth, however, conveys to the patient emphasis and force and directness that tons of tomes cannot.

12. At home and abroad, in the desert or on the ocean, in the lowlands or upon the mountains, patients may do well, as they recover anywhere and everywhere, for it matters less where than how they live.

13. Fresh air, one hundred times more frequent outside than in, depends for its value far more upon the temperature, moisture and movement of the air than upon any organic or inorganic constituents.

14. The skin demands better air than the lungs, for we can breathe with impunity far worse air than we can live in. Hence the lungs are benefited by fresh air no more, no less, than any other organ.

15. The dose of fresh air needs less attention than the development of a fresh air conscience which suffers when its owner crosses the threshold into the house.

16. For those who spend at least eight hours out of doors sleeping out does not hasten recovery provided they sleep in well ventilated rooms, but for those forced to be indoors during the day it is a *sine qua non* of continued arrest.

17. The sanatorium, the best place in which to treat patients in large numbers, has shown that permanent arrest may follow effectual treatment; the hospital has afforded evidence that direct contagion may in part be controlled, while the dispensary has become the advanced attacking line, so to speak, that carries the warfare into the enemies camp, that is, into the home of the tuberculous, and disposes of the wounded in a proper way.

18. The length of stay in these institutions depends upon the object to be attained: for permanent recovery two to three years, for quiescence at least three months; for prevention of infection from far advanced cases, as much as possible of the time between admission and death.

19. Give your patient as little food as will serve his purpose and have clearly in mind what this purpose should be: to gain up to and ten to twenty pounds beyond his usual weight.

20. Remember that too much food may in the end prove as disastrous as too little food, and furthermore that it is a great pity to waste good food.

21. See that your patient has a well balanced ration and, if you wish him to gain weight, increase his carbohydrates.

22. When anorexia appears upon the horizon, and simple tonics cannot dispel the bugaboo, do not fail to resort to fluids and fluids only without a bite to chew.

23. Injury demands rest for repair. Scar tissue ever forms but slowly.

24. Insistence upon absolute quiet and its observance for six weeks affords rest for repair, time for growth of scar tissue and opportunity for the walling off of areas of disease in the early stages. Such periods of rest in later stages accomplish no such results.

25. When such a period of rest has been practised, exercise can be more quickly increased with little danger of relapse.

26. Exercise should be regarded as a powerful and dangerous medicine, to be used carelessly never, with impunity by none, and as a deadly drug by all.

27. Work for therapeutic purposes is fraught with much danger and is more safely replaced by work which fits the patient for his future occupation.

28. Since the vast majority of patients must seek treatment only in the climate in which they contract the disease, the so called climatic treatment is of importance to hardly more than 5 per cent of all patients.

29. Change, change of food, change of work, change from work to rest, change of environment, change of climate, in fact any change that stimulates nutrition sufficiently helps toward recovery.

30. Those with acute tuberculosis, cachexia, marked dyspnoea with cyanosis, advanced nephritis, diabetes without carbohydrate tolerance, intractable diarrhoea, extensive laryngeal tuberculosis with dysphagia, or pneumothorax, are best treated in a hospital near their homes.

31. It is criminal to advise an untrained patient to seek benefit from climatic change without constant medical advice.

32. Resilient youth responds to strong stimulation while more rigid age requires protection.

33. As a rule a patient should be sent to as cold a climate as he can react to and enjoy.

34. Beyond the empirical fact that many patients do better for some change, much has been written but little proved about climatic treatment.

35. Climates of high altitudes unquestionably exert the greatest physiological effect upon the human economy.

36. There is as yet no accredited specific (like "606" in lues) for tuberculosis.

37. Drugs may alleviate or even remove for the time being certain localizing and constitutional symptoms but affect in no direct way the disease that produces them.

38. Haemotherapy and organotherapy have only historical interest, while serotheraphy has greatly disappointed many of its most ardent followers. Zomotheraphy may be an exception but it is to be used rather as a food.

39. Bacteriotherapy, that is, the injection of attenuated (for the species) living tubercle bacilli has given the most promising results so far but immunity so produced is not lasting and not applicable to man. The use of antagonistic bacteria (like the seton of old) is chiefly of historical moment.

40. The tubercle bacilli or their products, otherwise known as tuberculin, the most widely used of all socalled specific agents, have not given, when subjected to cold impartial statistical study, the results claimed by the enthusiasts.

41. In a few cases remarkable recoveries occur in patients taking tuberculin which are, in my opinion, more than coincidences. These keep alive the treatment.

42. The effect of tuberculin upon any individual symptom or patient is at present most uncertain and in all comparisons of treatment the time element and the selection of patients must be carefully considered.

43. The time may yet come when by the use of complement fixation or other means we may be able to select the proper antigen and so space and grade the dose, that, removing tuberculin from the field of empiricism, we can use it more successfully in the treatment of certain cases of tuberculosis.

44. He who deals with statistics upon which the lives of others may depend should have more knowledge of statistical work than will suffice only to compute averages and often erroneously to compare them.

REFERENCE

(1) BROWN, L.: Jr. Am. Med. Assoc., 1915, lxiv, 1917.

# THE DIAGNOSIS OF PULMONARY TUBERCULOSIS[1]

LOUIS HAMMAN

*From the Medical Clinic of the Johns Hopkins Hospital, Baltimore, Maryland*

Everyone interested in tuberculosis views with dismay the paucity of incipient cases. Sanatorium physicians have demonstrated that the outlook for recovery from pulmonary tuberculosis varies directly with the earliness of diagnosis, and surely no one will accuse them of ever missing an opportunity to thrust this fact boldly down the professional throat with an admonition to heed the obligation it imposes. When the anti-tuberculosis campaign was started on its eventful course, the cry was, "Tuberculosis is a preventable and curable disease." Indeed, stress was laid mainly upon it being a curable disease, and much of the energy of the campaign was directed towards stirring up the profession to a realization of the wonderful opportunity awaiting their coöperation. It was assumed that every case of pulmonary tuberculosis has an early stage; that this early stage can be diagnosed by the skilful; that early diagnosis insures recovery, and, therefore, that the solution of the tuberculosis problem depends in large measure upon the diagnostic skill of the medical profession. These convictions and hopes were loudly proclaimed and physicians were publicly censured for their deplorable inaptness in pulmonary diagnosis. During the past ten years there has been agitation enough to insure consideration for the problem of early diagnosis, and interest has been as widespread as could have been reasonably anticipated. However, cases of incipient tuberculosis are almost as rare to-day as they were ten years ago. Is it not odd, surrounded as we are by so many cases of pulmonary tuberculosis, that the early stages of the disease persistently elude us? How can we explain this paradox? Does the cause reside in the apathy of patients who delay presenting themselves for examination? Is the medical profession indifferent? Are the technical difficulties of the methods of investigation so exacting that only the few can master them? Or finally, does the course of the disease present obstacles that are well nigh insurmountable?

[1]Read before the Academy of Medicine, New York City, February 3, 1916.

We are told that the symptoms of early tuberculous infection are insidious, often trivial indeed, so that they usually fail to alarm the patient and are disregarded by the physician. I need say no more upon such a familiar topic, for no doubt you have all read with chagrin the tables compiled by sanatorium physicians showing the number of months and years that often elapse between the date when symptoms first prompt the patient to consult a physician and the time when he at last is advised of his true condition and urged to accept serious treatment. Indifference to apparently trivial symptoms and complacent faith in the healing virtue of time often encourage a physician to substitute a routine prescription and jovial reassurance for a thorough examination. Mistakes are due far more commonly to carelessness than to the difficulty of diagnostic methods. When the presence of pulmonary tuberculosis is suspected and the question is once honestly asked, the answer seldom escapes a conscientious investigation. The undue emphasis that has been put upon the physical examination, by distracting attention from other no less important factors, has rather obstructed than facilitated early diagnosis. It will never be possible for physicians as a class to reach unusual finesse in percussion and auscultation, whereas the simpler methods of clinical observation may be accurately made and correctly interpreted by all.

The apathy of patients, the indifference of physicians and the difficulties of the methods of investigation partly explain the rarity of incipient pulmonary tuberculosis, but they do not account for it fully, because the condition is seldom recognized, even by the most vigilant and skilful. For ten years I directed a large tuberculosis clinic, and, after rigid standards of diagnosis had been enforced few definite cases of pulmonary tuberculosis could be classified in the incipient group. Interest was not wanting, because we were specifically looking for tuberculosis; the staff was expert in diagnostic measures, because they practised them daily; and the most promising material was at hand, for not only were patients with definite symptoms investigated, but also a large number of exposed individuals from amongst whom one would expect to pick out many early cases. Therefore, there must be some inherent traits in the progress of tuberculosis that render the detection of early stages difficult and indeed in many instances impossible. This fact must be clearly understood before we proceed to an intelligent discussion of the methods of diagnosis.

# THE DIAGNOSIS OF PULMONARY TUBERCULOSIS[1]

LOUIS HAMMAN

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Everyone interested in tuberculosis views with dismay the paucity of incipient cases. Sanatorium physicians have demonstrated that the outlook for recovery from pulmonary tuberculosis varies directly with the earliness of diagnosis, and surely no one will accuse them of ever missing an opportunity to thrust this fact boldly down the professional throat with an admonition to heed the obligation it imposes. When the anti-tuberculosis campaign was started on its eventful course, the cry was, "Tuberculosis is a preventable and curable disease." Indeed, stress was laid mainly upon it being a curable disease, and much of the energy of the campaign was directed towards stirring up the profession to a realization of the wonderful opportunity awaiting their coöperation. It was assumed that every case of pulmonary tuberculosis has an early stage; that this early stage can be diagnosed by the skilful; that early diagnosis insures recovery, and, therefore, that the solution of the tuberculosis problem depends in large measure upon the diagnostic skill of the medical profession. These convictions and hopes were loudly proclaimed and physicians were publicly censured for their deplorable inaptness in pulmonary diagnosis. During the past ten years there has been agitation enough to insure consideration for the problem of early diagnosis, and interest has been as widespread as could have been reasonably anticipated. However, cases of incipient tuberculosis are almost as rare to-day as they were ten years ago. Is it not odd, surrounded as we are by so many cases of pulmonary tuberculosis, that the early stages of the disease persistently elude us? How can we explain this paradox? Does the cause reside in the apathy of patients who delay presenting themselves for examination? Is the medical profession indifferent? Are the technical difficulties of the methods of investigation so exacting that only the few can master them? Or finally, does the course of the disease present obstacles that are well nigh insurmountable?

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Pulmonary tuberculosis does not always begin in the insidious fashion that propagandists delight to picture. Quite as commonly it settles abruptly upon the victim and at once involves such a large area of lung and produces such acute symptoms that the disease has no early stage. There is a widespread impression that pulmonary tuberculosis starts with the eruption of a few tubercles at or near an apex; that these tubercles caseate and allow the formation of fresh tubercles which in turn break down and liberate more bacilli for further implantation; that only indefinite local and systemic symptoms accompany the beginning invasion, the evidence of pulmonary irritation and of general intoxication coming gradually to light with the slow spread of the infection. Fortunately, the disease does sometimes develop thus benignly, and, when it does, we have an opportunity to use our diagnostic skill to good purpose. However, I am convinced that just as often it strikes unexpectedly and without warning, riddling half a lobe, a whole lobe, or a whole lung with tubercles, transporting the patient at a stroke from perfect health to a moderately or far advanced stage of the disease. There is here no chance to display diagnostic skill, for we are totally ignorant of the subtle warnings, if there be such, that foretell the coming catastrophe.

A man starts out in the morning upon his affairs in good health. In the afternoon he feels chilly, has a fever and takes to his bed. The fever persists and cough comes on. Examination of the lungs shows at first suspiciously little in proportion to the symptoms but later a whole lobe is found involved. Another in full health has a frank haemoptysis followed by a similar train of symptoms.

Surely we cannot admit that every case of pulmonary tuberculosis has an early stage and that this early stage can be diagnosed by the skilful. Still such abrupt pulmonary outbursts are always preceded by infection, and a focus of disease must have been lying dormant in the lung or in a gland. Perhaps if we paid more attention to the discovery of latent infection we might by appropriate measures ward off these disastrous clinical manifestations. The aim is worthy of the most serious consideration.

There is one difficulty in the way of early diagnosis of pulmonary tuberculosis that has no counterpart in any other infection. It is important at once to make this difficulty clear, for when understood many disturbing problems are readily explained. In all other infectious diseases infection and disease are practically synonymous terms for when a person is infected with a particular organism he has the associated dis-

ease, and when he is well of the disease he is nearly always rid of the infection. Even carriers who harbor germs without being made ill by them are scarcely exceptions to the statement because when discovered they are, on account of their danger to the community, particular objects of solicitous care and treatment. Not so in tuberculosis where the aim of diagnosis is a nice distinction between infection and disease. I need not refer to the statistics, they are so well known, that show the almost universal infection of man by the tubercle bacillus. Fortunately in most of us the infection passes unnoticed and it acquires clinical importance only when it advances far enough to give disturbing evidence of its presence. It is perhaps not sufficiently appreciated that our methods of detecting tuberculous infection are just as delicate and accurate as our most reliable means of discovering other infections. The great practical difference in the value of these measures depends entirely upon the relative clinical importance of infection as an indication of disease. In tuberculosis the problem of early diagnosis is not to discover the first evidence of invasion by the bacillus, nor to seek out hidden foci of infection, but to detect if possible the stage when latent infection threatens to pass into active disease. The portents of this stage are not at all easy to discern and sometimes the transition is executed so rapidly that recognition defies the most alert skill.

Therefore, the way pulmonary tuberculosis develops is just as important a barrier to the satisfactory recognition of early stages of the disease as are the indifference of patients and physicians and the lack of diagnostic skill. It is not true that every case of advanced pulmonary tuberculosis is a blot upon our professional reputation, and there is some solace in this consideration, for our conscience has already to bear the reproach of many shortcomings. However, it is not my purpose in dwelling upon these facts to offer an excuse for relaxing the eternal vigilance that is the price of even an occasional early diagnosis. I mean only to call to your attention the great difficulty of solving the problem before us and to emphasize that the early diagnosis of pulmonary tuberculosis, instead of being a simple means to control tuberculosis as a disease of the masses, is instead perhaps the most exacting test to which a physician must submit his skill and judgment.

I have said that it has been customary in reaching a diagnosis of early pulmonary tuberculosis to look to the physical examination for a final decision. Fostered by this custom percussion and auscultation have been practised so assiduously that to the skilful they now yield minute

details heretofore ignored. The slightest change in the percussion note and in the character of the breath and voice sounds is readily detected and that these slight changes really correspond to definite pulmonary alterations has been abundantly confirmed by Roentgen ray examinations. The enthusiasm aroused by this satisfactory demonstration led to the belief that a solution of the difficulties of early diagnosis might be found in the refined practice of the arts of percussion and auscultation. A patient with symptoms, even though vague, who presented slight abnormalities at an apex was diagnosed incipient tuberculosis, and the glowing results of proper treatment were the anticipated reward of this enlightened judgment. However, it was soon found out that slight apical changes are commonly present even in apparently healthy persons, and that many patients who refused to follow the salutary therapeutic recommendations based upon this discovery still failed to develop the expected advance of the pulmonary disease. I have been particularly interested in this special field of pulmonary diagnosis, no doubt on account of my early enthusiasm and the disappointment of later experience. A few years ago Dr. Baetjer and I made a very careful study of fifty healthy young men, comparing the results of physical examination with the Roentgen ray findings, and we were surprised at the large number who showed definite pulmonary abnormalities and at the extensive lesions that were present in some. Finesse in percussion and auscultation does not carry us to the end of our diagnostic road; for the lungs of most adults and indeed of many children show the scars of numerous lesions, and with our present methods of observation we are unable to determine at what time the injury was inflicted. I am willing to admit that most of the scars are from tuberculous lesions, but the undisturbed good health of many of those who have such scars convinces us that the wounds were received years before, and that the injury even at that time was trivial. Therefore these slight apical abnormalities are evidence of infection and not of disease and taken alone do not decide the diagnosis.

By slight apical abnormalities I refer to slight changes in the character of the percussion note and of the breath and voice sounds, and I wish specifically to exclude the presence of râles. Apical râles have such a direct and unquestioned significance in the diagnosis of pulmonary tuberculosis that they must receive separate consideration. With certain well defined restrictions, I would place the evidence they give us second only to the finding of tubercle bacilli in the sputum. By râles

I mean the definite moist sounds that are heard at the apices at the end of inspiration, and commonly enough only after cough, and I do not mean the various transient clicks and so called adventitious sounds that may simulate râles so closely and often puzzle the adept and mislead the novice. Definite moist râles at an apex when the other clinical findings point strongly to the presence of pulmonary tuberculosis practically assures the diagnosis. I cannot emphasize too strongly the importance of this evidence for not infrequently physicians who make otherwise a painstaking examination neglect to have the patient cough, and thus miss the opportunity of detecting the one conclusive feature of the investigation. Unfortunately, when we possess the assurance that râles give us, nearly always the patient already has passed out of the incipient group.

What I have said thus far of physical diagnosis applies only to those skilled above the average in percussion and auscultation. Although I have practised these arts assiduously, I still regard expert pulmonary examinations as the most difficult field of internal medicine. I am not hypercritical when I say that in my experience the majority of physicians never attain unusual skill in detecting slight pulmonary abnormalities, for I think we have no right to ask of them the special interest and arduous application that expertness in this department of diagnosis requires. There is little danger of the average physician finding too much in the lungs, for often lesions that are gross to the expert are to him sources of difficulty and uncertainty. I think perhaps something might be gained if his attention were directed more specifically to detecting râles. I remarked before that in my opinion much harm has been done the cause of early diagnosis by the undue stress put upon the physical examination in looking to it as the arbiter of all doubtful diagnosis. Many a grave suspicion aroused by the patient's history has been dispelled by the reassurance of a so called negative examination.

Since percussion and auscultation are arts so difficult that the average physician will never excel in their practice it is important to emphasize factors in diagnosis that are more readily determined. I hesitate to dwell upon the value of the patient's story in the early diagnosis of pulmonary tuberculosis and of the use of such commonplace instruments of precision as the thermometer and the scales. I feel as though I were doing violence to your self-respect in broaching such trite subjects, and only the firm conviction of their tremendous practical importance and the experience of many years that has shown me how often is despised

the valuable information they yield, encourages me to speak of them. At any rate, I may be brief, because the details of the subject are well understood, and the lack of appreciation comes from carelessness and not from ignorance. I have pointed out that the particular diagnostic problem presented by tuberculosis is to distinguish between infection and disease, and the surest indication of disease is the patient's symptoms. There are no symptoms peculiar to tuberculosis but a few isolated symptoms are so nearly characteristic that alone they make the diagnosis almost certain. There are moreover definite groups of symptoms so strongly suggestive of the disease that even in the absence of further confirmatory evidence one must assume its presence unless able to discover some other perfectly satisfactory explanation for the disorder. We have the knowledge, but often lack courage to act upon our conviction.

If I may illustrate: You would mock my presumption were I to preach the diagnostic importance of haemoptysis and of pleurisy with effusion, and still how few physicians act seriously upon such evidence. If tubercle bacilli appear in the sputum, Ah, yes! then the situation is grave enough. But does the discovery of tubercle bacilli really add anything to the assurance we already possess? It is difficult to put the matter squarely before a robust, vigorous man, even though he be temporarily alarmed by his symptoms. It may appear ludicrous to intimate that so vigorous a fellow is overshadowed by a mortal disease. I think also that a certain misconception which leads physicians to look upon a diagnosis of pulmonary tuberculosis as synonymous with a sentence of banishment to a sanatorium or health resort is responsible for much of the timidity. Haemoptysis is the initial symptom of invasion in nearly 10 per cent of patients with pulmonary tuberculosis. If the significance of this one symptom were conscientiously regarded, what a boon it would be to early diagnosis. I shall merely refer, but withal in sadness, to the neglect of the thermometer, that instrument to which modern medicine owes perhaps more than to any other instrument of precision. It is very easy to have a patient make a record of his temperature, and such data are a mine of valuable information. The importance of the distinction between infection and disease is illustrated by the current use of the phrases active and inactive. What better guide have we to activity than the patient's symptoms? I am convinced that early diagnosis would profit if physicians could be rid of the bugbear of physical examination, which exacts that every diagnosis be supported by gross changes in percussion and auscultation.

There is only one absolutely indisputable evidence of pulmonary tuberculosis, namely, the appearance of tubercle bacilli in the sputum. Unfortunately, this is but rarely a sign of early involvement. Nevertheless, it seems to me that in our eagerness to detect the very first stages of the disease we have somewhat neglected the value of sputum examinations. At least I get the impression that the sputum is not as carefully and conscientiously searched as it was fifteen or twenty years ago when it played a more prominent rôle in diagnosis. Even the simple microscopic inspection of sputum, irrespective of a quest for tubercle bacilli, has an important diagnostic bearing since a hurried glance usually suffices to distinguish true pulmonary secretion from the mucoid discharge raised from the nose and throat. Sputum examinations, to have value, should be performed frequently, and if there must be a choice, frequently in the usual simple way, rather than occasionally by more thorough and complicated methods. Perhaps it is superfluous to add, though the warning cannot be amiss, that negative sputum examinations have no value in excluding the presence of early pulmonary tuberculosis.

The Roentgen ray, which has done so much to assist us in the correct interpretation of gross pulmonary and pleural lesions, has proved of little help in the diagnosis of early pulmonary tuberculosis. I am embarrassed by the apparent nonchalance of this remark, but the estimate is really a deduction based upon wide experience and careful consideration. The Roentgen ray portrays slight pulmonary changes with remarkable precision and gives an objective and permanent record of conditions. In this respect we could ask no more of any method. However, the failure of the Roentgen ray to clarify early diagnosis is not due to any defects of the method nor to ambiguity in the results it yields, but to the difficulties inherent in the problem, difficulties that the Roentgen ray cannot penetrate. I need not dwell upon these difficulties in detail, since they are the same obstacles that stand in the way of diagnostic solution through finesse in percussion and auscultation. A large proportion of healthy adults shows apical abnormalities on physical examination, and a still larger number shows abnormalities in density to Roentgen ray illumination. I have never seen the plate of an adult's lungs that could be called normal. Our idea of the normal is a composite picture of many almost normal plates. The anatomical interpretation of Roentgenograms is simple enough, but the clinical interpretation is uncertain because they give us no etiological or physiological informa-

tion and therefore fail to distinguish between active and inactive lesions, which is the one important matter upon which we seek a decision. In this respect the Roentgen ray has all the shortcomings inherent in physical examinations. Indeed, it has these shortcomings to a still greater degree, for it tells us only of density, whereas auscultation discloses moisture as well. The practical value of the difference needs no further emphasis.

There remains still to be considered a very interesting and not unimportant element in diagnosis. I refer to the various immunity reactions that have been of inestimable value in the clinical study of other infections. It was partly to prepare for their consideration that I insisted previously upon drawing a sharp distinction between tuberculous infection and tuberculous disease, for immunity reactions are indicators of infection, or rather, of the response to infection, and have clinical value only to the extent to which infection means disease. Agglutination reactions, warmly advocated by Arloing and Courmont, have been abandoned as valueless. The opsonic index has gone the same way. Complement fixation has so far proved little more successful; but the recent investigations of Besredka that have been confirmed in this country, and the interesting studies being made by Petroff at Saranac Lake encourage us to hope for results of more practical value in the future. The one immunity reaction that continues after years of hard usage to sustain diagnostic importance is the tuberculin test. I should like to discuss the tuberculin reaction in detail, because of the misunderstanding that has clung about it in spite of exhaustive and illuminating investigations. My own interest in this subject also invites prolixity. Nevertheless, I promise to be brief, and I believe I can, in a few words, make clear the practical issues.

Tuberculin is an indicator of infection, and nothing more. If that fact be borne in mind, all other deductions must appear reasonable. That tuberculin has proved itself of only confirmatory value in diagnosis, and to many has been exasperatingly equivocal, is due solely to the unexpected prevalence of infection. We really have no right to ask other clinical evidence of tuberculin than that it shall indicate which individuals are free from infection or have completely overcome infection, and this it does with almost absolute certainty. But it does even more than this. In the first place, if given in the proper way and in the proper dose it causes a reaction about the tuberculous lesion, and if we are able to discover this focal reaction the tuberculous nature of the

lesion is assured. In the second place, the degree of tuberculin hypersensitiveness varies somewhat with the stage and the extent of the tuberculous process. Thus active lesions are usually accompanied by a higher grade of hypersensitiveness than old quiescent lesions. However, clinical deduction based upon the degree of reactions must ever be only of relative value, for while slight, torpid reactions favor the presence of unimportant quiescent lesions, and marked sharp reactions lead us to expect fresh advancing disease, still this rule is by no means constant, and between the two extremes there is wide overlapping. Therefore, if we make the test very sensitive, it not only includes all clinically tuberculous or active lesions, but nearly all inactive foci as well and, if we make the test less delicate, then most inactive, but at the same time many active lesions fail to respond. Tuberculin will never draw a sharp line between infection and disease, and we have no right to expect it to make this distinction. Let me add that under some conditions, mainly when the disease is far advanced or quickly advancing, patients fail to react to tuberculin, in spite of being obviously tuberculous, and with this addition I think you have a safe foundation for the practical interpretation of the tuberculin tests.

A physician desiring to apply the tuberculin test must have clearly in mind just what information he seeks. Let us suppose that a patient presents symptoms suggesting a beginning pulmonary tuberculosis with no, or only indefinite, physical signs. Knowing that a failure to respond to tuberculin will dispel his uncertainty, the physician decides to give the test in the hope that it may be negative. If this be his intention he must realize that a positive reaction will add little to the clinical data he already possesses,—he stakes all his hope on the failure of the patient to respond. For this purpose he may use the subcutaneous, the intracutaneous or the cutaneous test. The subcutaneous test is the most certainly eliminating test that we possess. If a patient fails to react to ten or even to five milligrams of old tuberculin we may feel assured that he has no early active lesion. The intracutaneous test, if performed with appropriate dilutions of tuberculin, has a value almost equal to the subcutaneous test in excluding tuberculosis. Of somewhat less value than these two, on account of its gross technique, is the cutaneous test. However, the cutaneous test is so very simple that it may be used routinely with little demand upon the time of the physician and with no inconvenience to the patient. It is true that about 70 per cent of healthy adults react to the cutaneous test, but the few suspicious cases

that fail to react fully repay the physician for the trivial expenditure of time and trouble that the routine application of the test demands.

Again let us suppose that a patient has some obvious lesion but the tuberculous nature of the lesion is in question and the physician seeks light upon this problem. If the lesion is readily accessible to our methods of exploration he may decide to attempt the production of a focal reaction. For this purpose the subcutaneous test must be used and fairly large doses administered so as to provoke a sharp reaction. For lesions open to inspection the method is invaluable since a focal reaction at once decides the diagnosis. The difficulty in the way of its broad application is that most tuberculous lesions are in the internal organs, and the focal reaction, when it occurs, easily escapes detection. For instance, in pulmonary disease it is often possible during a tuberculin reaction to discover changes in a definite lesion, but it is uncommon to observe focal reactions in the very slight apical lesions that offer the main difficulty to early diagnosis.

Finally, let us suppose once more that a patient suspected of having tuberculous disease does react to tuberculin but the lesion is unfavorably situated for detecting a focal reaction. Still the physician may wish to get some idea of the patient's degree of hypersensitiveness. This is a very praiseworthy desire, and I am confident that such estimations are often of great value in diagnosis; but let the physician beware, for he has now entered a treacherous field where only experience and caution can safely guide his judgment. For this purpose he may use the cutaneous or the intracutaneous test performed with serial dilutions and thus roughly decide the threshold of the patient's hypersensitiveness, or he may use the conjunctival test. Of the former two, the intracutaneous test is the more accurate, the cutaneous test cruder, but much easier to apply. As I have already stated, a high degree of hypersensitiveness speaks for activity; a low for quiescence; but there are many exceptions and wide overlapping, so that great caution must be observed in drawing clinical inferences. The conjunctival test must be considered alone because it is an empirical gauge of hypersensitiveness and what value it has depends upon the chance relation that exists between the reaction and the extent and activity of the tuberculous disease. I am well aware of the disrepute into which the conjunctival test has fallen, and I willingly admit that it should not be used generally nor indiscriminately. However, I am convinced that with proper care the test may be safely employed, and I am indebted to it for so much valuable aid that I should

regret to see it completely abandoned. It would be unjust after what I have said to accuse me of stating that the conjunctival test is an indicator of active tuberculous disease. No tuberculin test can ever be that; but it does so happen that reaction to the 1 per cent tuberculin conjunctival test seldom occurs in the absence of tuberculous disease of clinical importance. A failure to react is of no value in excluding tuberculous disease.

In conclusion I wish to summarize the impressions I should like you to carry away from my remarks. A large number of tuberculous patients never pass through what could be called clinically an early stage and therefore we have not the opportunity to detect the disease in this favorable period. In those instances where the disease comes on more slowly early diagnosis will be favored by putting a careful clinical study of symptoms above the censorship of percussion and auscultation. Sputum examinations, the Roentgen ray and the tuberculin tests are valuable additional aids, but the information furnished by the Roentgen ray and by tuberculin must be cautiously interpreted. The great obstacle in the way of early diagnosis is the difficulty of separating tuberculous infection from tuberculous disease. If we can ever distinguish clinically that nice point where latent infection first passes into threatening activity the problem of early diagnosis will be solved. At the present time this point is blankly obscure and we have no means of deciding definitely which doubtful cases are within safety, which have just passed without and which are hovering about the threshold. Therefore, the early diagnosis of pulmonary tuberculosis is nearly always a probability diagnosis for when absolute evidence appears the disease is seldom in an early stage. There will always be differences of opinion among clinicians about such diagnoses and about the evidence upon which they rest. The important lesson for the physician is that while he must investigate thoroughly and judge cautiously, still he must be willing to act upon reasonable probability and not allow the patient's life to be thrown away as he calmly awaits the full verification of his suspicions. The important lesson for the sociologist is that he must see the insuperable difficulties in the way of early diagnosis on a large scale and abandon his efforts to make early diagnosis an essential feature of the campaign for the eradication of tuberculosis.

# PARAFUCHSIN AS A STAIN FOR TUBERCLE BACILLI

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Basic fuchsin or "fuchsin for bacilli" as it is known in the bacteriological laboratory is either the hydrochlorid or the acetate of a mixture of rosanilin and pararosanilin. In this mixture the salts of rosanilin predominate. This mixed product has long been made by the oxidation of a crude anilin known as "anilin oil for red" which contains in addition to anilin, variable quantities of orthotoluidin and paratoluidin. Anilin oil for red is the result of the nitration and reduction of an impure or "crude" benzol containing considerable amounts of toluol. If instead of this "oil for red," pure anilin is used as the starting point for the manufacture of fuchsin, the resulting dye consists wholly of pararosanilin.

Under present conditions the demand for toluol in the manufacture of explosives is so great that the "oil for red" is no longer available, practically pure anilin alone appearing in the market. As soon as the supplies of fuchsin from European sources become exhausted, bacteriologists will have to use the American product, which, as has been indicated, is entirely pararosanilin.

Accordingly we have thought it advisable to examine the staining qualities of pararosanilin, particularly as to its suitability for use in the make up of the ordinary carbol fuchsin for staining the tubercle bacillus. Our examination has resulted as follows:

Pararosanilin is somewhat less soluble in alcohol than the mixed product known as "fuchsin für bac." obtained from Grübler. It is much less soluble in water and in water containing phenol and some alcohol. As a consequence of this, if any of the accepted formulas for carbol fuchsin are followed, a turbid mixture results which has no staining power because there is almost no dye in solution. The difficulty is overcome very simply by the use of a quantity of the saturated alcoholic solution twice that usually employed for "Fuchsin Grübler."

The method of employing pararosanilin is then:

1. Make a saturated alcoholic solution.
2. Add 20 cc. of this to 80 cc. of a 5 per cent solution of phenol.

The result is a clear solution of about the same color intensity as the usual carbol fuchsin. We have employed it to stain tubercle bacilli on the slide in the usual manner with complete success. When heated over the free flame the alcohol burns off and there is somewhat more rapid precipitation of the dye than there is with the old preparation. In the meantime staining has however taken place with the usual intensity and the resistance to decolorization by acids is the same.

We have not employed this stain in the manner used in many laboratories where large numbers of slides are stained at one time in an open vessel to which heat is applied, but it is to be expected that under these conditions alcohol would have to be added from time to time in order to keep sufficient dye in solution.

## CONCLUSION

Pararosanilin salts have the essential staining qualities of rosanilin salts, and the tubercle bacillus when stained with them, resists decolorization with acids in the same degree. Owing to difference in solubility, the solutions of pararosanilin salts must contain more alcohol in order to be effective. A formula is given for the use of pararosanilin in the make up of carbol fuchsin.

# EXPERIMENTAL TUBERCULOSIS IN GUINEA PIGS FOLLOWING PRELIMINARY TREATMENT WITH TUBERCULIN BY THE NOSE

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As the result of a prolonged investigation by two of us (1) it was concluded that when horse serum is dropped into the nose of a guinea-pig in a series of spaced instillations the biological reaction towards intravenous injections of the antigen is profoundly modified.

We found that the quality of the effect produced by the toxic injection depended upon the quantity of serum used at each preliminary instillation and on its intimacy of contact with the mucous membrane of the nose, that is, obviously, upon the amount of serum absorbed. When, say, 0.2 cc. of serum was instilled during a period of three minutes, and the process was repeated on alternate days for four doses, an intravenous injection of 0.25 cc. of serum sixteen days after the last instillation would nearly always result in speedy anaphylactic death.

When, however, the dosage at each instillation was reduced to 0.04 cc. and the time of administration, during which the animal was held upon the back with head extended, was lessened to about one minute, then the toxic injection usually provoked little or no response and, what is particularly noteworthy, subsequent and increasing intravenous injections of the antigen at wide intervals were usually withstood with comparatively slight anaphylactic reaction.

In a further series of experiments (2), with the coöperation of W. C. Mitchell, we found that the fresh blood serum of guinea-pigs which had thus withstood the repeated injection of horse serum through several months, when injected intraperitoneally into normal pigs, could confer upon the latter the ability to withstand easily a series of spaced injections of horse serum, the second of which always proved fatal in controls. On the other hand, the serum of guinea pigs which had been rendered sensitive to a toxic injection, when injected into normal animals, as is well known, renders these fatally sensitive to toxic injection. Defining "immunity" as a state of generalized physiological

resistance against a given antigen, our experiments seemed to show that this condition could be experimentally reached as to horse serum without the development of extraordinary anaphylactic sensitiveness, just as one of us demonstrated long ago that tolerance to snake venom might be induced (3).

The deduction is irresistible that, if we dare assume a biological analogy between bacterial proteins and those of horse serum, we might expect to be able, through the probably well nigh infinitesimal absorption by way of the nasal mucous membrane, to so raise the threshold of irritability of living cells against the contents and products of pathogenic germs that large injections of the antigens could be tolerated and thereby resistance raised to any level.

It was pointed out (1) that the clinical course of accidental bacterial infection could be well explained if we admit that the primary effect of toxic material upon the body is to vaccinate or to sensitize it according to the amount entering the circulation at the outset and that the stability of the organism towards subsequent poisoning is determined thereby. In this point of view we find a rational basis for the urgent advice of a surgeon (4) that when an infection of the finger is acquired the arm should be kept in a sling for two days. With the extremity at rest the body is vaccinated by the minimal toxic absorption, while with habitual exercise the hurried circulation transports a sensitizing dose.

The writer has been brought by purely clinical experience to take a similar view as to the vital relations of tuberculous adenitis in children. A mild tuberculous infection of the lymph glands would seem ideally fitted to distribute through the body that minimal toxic dosage which we have assumed would vaccinate and would thereby raise resistance toward the advent of pulmonary disease.

But a sufficiently severe glandular infection might be expected to have the contrary effect; it would sensitize the lungs and render them more accessible to tubercular invasion. The wise practitioner of medicine recognizes the essential difference between the possibly protective anatomical tuberculosis and the disastrous clinical disease. The important therapeutic fact is that the development of the disease is largely under control of manageable hygienic conditions.

When a child with demonstrable enlargement of the bronchial glands loses weight and vigor, that is, manifests clinical symptoms of disease, hygienic neglect is fairly sure to be followed by the development of pulmonary tuberculosis. On the other hand, when the warning is

apprehended, the child is taken out of school, an outdoor life is instituted, nutrition is improved, the "run down" condition gives way to health and the whole occurrence becomes a casual episode.

The biology of the infected is determined by the ratio of two ever changing variables, namely resistance and virulence. Similar results may follow an increase in the numerator or decrease in the denominator.

We know of no literature bearing directly on our subject.

There is a widespread and growing belief that a successful combat waged by the body against tuberculous infection specifically augments the resistance of the victor. Such resistance is admittedly relative, as was foreshadowed in one of Koch's original experiments (5) wherein a dog recovered from disease induced by intraperitoneal inoculation with a small dose of tubercle bacilli; five months later the animal received a large injection and died of tuberculosis.

If animals can be sensitized to tuberculo-protein by the injection of tuberculin it seems reasonable to suppose that they might in the same way be vaccinated against tuberculosis, though Krause has recently pronounced directly the contrary, that "sensitization of non-tuberculous guinea pigs with tuberculo-protein does not alter their resistance to experimental tuberculous infection" (6).

Baldwin (7), apparently with considerable difficulty, was able to thus sensitize guinea pigs. He concludes:

> A single injection of tuberculo-protein equal to 0.0008 gram, dry weight, is sufficient to sensitize a normal guinea pig; probably even less is required. . . . . Sensitization is possible with both the filtered bacillary extract and the well-washed residue.

Krause (8) likewise found that small intradermal injections of the filtered watery extract of tubercle bacilli plainly sensitized guinea pigs to the post orbital injection of the same protein.

In our own work the signs of sensitization produced by the use of tuberculins, including Baldwin's filtered watery extract, were mostly exceedingly feeble and uncertain. Krause (9) showed that the evidence for the passive transfer of tuberculosis sensitiveness may be founded on the primary toxicity of intravenous tuberculin injections.

Austrian (10) injected young guinea pigs intraperitoneally with the blood of tuberculous patients and twenty to forty-eight hours afterward tested the animals with intracardial injections of Baldwin's tuberculo-protein. The results were negative.

Theobald Smith (11) has recently reviewed some important work done by himself and others. Smith found that calves inoculated intravenously with living cultures of tubercle bacilli of low virulence acquired a well marked resistance towards the subsequent implantation of tuberculosis, as compared with controls. It is noteworthy that the preliminary injection of tubercle bacilli killed by heat conferred no such increase of resistance. In our own work it appeared that intravenous injections of tuberculin prior to inoculation with virulent tubercle bacilli decidedly prolonged the lives of guinea-pigs as compared with unvaccinated controls.

Finally Krause (12) in his exhaustive researches on the relations of tuberculin hypersensitiveness to tuberculosis immunity confirmed the results obtained by Baldwin and investigated essentially the same problem set ourselves, though by different methods.

In the effort to try out our conception of the biological analogy between horse serum and bacterial protein we were forced by circumstances to begin with the pathogenic organism which offered *a priori* the least hope of giving positive results, the bacillus of tuberculosis. Though the outcome of our work bears out this discouraging anticipation, for we have not been able to demonstrate any certain vaccinating influence of tubercle bacillus antigens administered by the nose, it seems desirable that our experiences should be placed on record. Briefly expressed, we have investigated in a new way an old question, namely: Can immunity towards tubercular infection be induced in guinea pigs by a preliminary course of treatment with tuberculin?

Our method of procedure involved in succession: (1) A course of intranasal instillations with tuberculin. (2) A series of widely spaced intravenous injections with tuberculin of the treated animals together with a number of otherwise untreated controls. (3) Finally all animals received, either subcutaneously or intraperitoneally, a definite suspension of virulent tubercle bacilli, a number of fresh, untreated controls receiving simultaneously the same infecting dose.

## MATERIAL AND METHOD OF THE WORK

Three different preparations of tuberculins were used in this investigation, for which our warm thanks are due to the donors. To Dr. E. R. Baldwin we are indebted for a Berkefeld-filtered water extract of tubercle bacilli which had been cultivated from sputum and had been

found to be of average virulence for guinea-pigs. The extract contained the protein substance of the bacilli and was preserved with toluol; and the evaporated fluid left a residue weighing a little over 1 mgm. to the cubic centimeter. It can be identified as the extract of $H_{37}$ in the appendix to Baldwin's well known paper (7). The extract was said to sensitize guinea-pigs to tuberculo-protein. For the other two preparations we are indebted to the Cutter Laboratory of Berkeley, California. They were made from human strains and were designated as bacillary emulsion (B. E.) and tuberculin residue (T. R.) respectively. These designations will be retained though the descriptions furnished of the methods of preparation show that both were unfiltered watery emulsions of virulent human bacilli which had been heated to 60°C. for an hour. In the preparation the bacilli were washed free from culture media in normal salt solution, dried in vacuum, ground thoroughly in agate and extracted with water. The undissolved substance was thrown down by centrifugation and successively extracted until there was practically no residue left. In the case of the "T. R." the first, most toxic, washing was discarded. The various waters used in the extraction were added together, standardized as to solid contents and preserved with 50 per cent glycerine and 0.4 per cent trikresol. The preparation, "T. R," contained 2 mgm. of dry matter to each cubic centimeter. This extract when received by us had been conserved in glass ampules for probably two years or more. The "B. E." tuberculin when evaporated left a residue of 10 mgm. to each cubic centimeter. Its culture had been contaminated with a nonpathogenic, spore bearing germ resembling the hay bacillus. The timothy bacillus protein, according to Baldwin, does not modify the action of tuberculin.

The conduct of our experiments was essentially similar to that already described in our work on horse serum. Twenty-four young male guinea pigs weighing 150 to 300 grams each were divided into three equal groups for treatment with the various preparations of tuberculin. Four animals of each group were instilled by the nose with two small drops, representing together about 0.04 cc. of the chosen tuberculin. The remaining four animals of the same group received from three to six times that quantity. The amount of fluid remaining in contact with the mucous membrane of the nose was less by an undetermined amount than that introduced by reason of the expulsive movements of the animal. The act of instilling the smaller dosage was completed in about one minute, that of the larger in three minutes. The treatment

was repeated every second or fourth day for five or six occasions. Thirteen to sixteen days after the last instillation each group of eight pigs received an intravenous injection of the tuberculin to the amount of 0.25 cc. for the first injection. At the same time three untreated pigs of about the same weight, as controls, were given a like injection. Before injection into the vein each tuberculin was salted to bring its sodium chloride content to about 0.75 per cent, but no effort was made to remove the preservative.

As already stated, the object of our work was to discover whether the absorption of tuberculin by the nose could immunize or sensitize, respectively, against tuberculo-proteins injected into the vein, according to the analogy already developed in the case of horse serum, and finally, whether such treatment could retard or accelerate the development of experimental tuberculosis.

The various groups of guinea-pigs received a total of three to five intravenous injections of the tuberculins and were then allowed to rest for a period of fifty-six to one hundred and twelve days when they were inoculated with a culture of virulent human tubercle bacilli. With the thirty pigs which had undergone preparation there were inoculated at the same time and, with the exception noted, with the same dosage eleven normal controls.

The culture of human tubercle bacilli used for inoculation was kindly given us by Dr. H. G. Wells who had isolated it from sputum in his laboratory at the University of Chicago. It had been found to possess extraordinary virulence for guinea-pigs. The animals in lots IV to IX and the first eight in lot X were inoculated on November 19, 1917, from the original culture, and the remainder on December 10 from a subculture grown from it. In preparing for the injections the clumps of bacilli were ground in a mortar in physiological salt solution and the supernatant fluid transferred to a stoppered bottle. The suspension was well shaken in this vehicle and, after settling a few minutes, the fine emulsion was injected either subcutaneously or intraperitoneally in doses of 1 cc. Care was used to obtain a like density of suspension in all injections. As the concentration of the mixture manifestly increased with withdrawal of the supernatant fluid, pigs belonging to the same lot, and also the controls, were inoculated early and late in the series of injections so as to establish any decided influence of difference in concentration of the bacillary suspensions. No such influence could be detected in the results.

In the case of pigs 7 and 8 of lot X (final controls) the emulsion was considerably thicker than ordinarily, but pig 8 received only 0.5 cc. instead of the full dose. The strong resistance manifested by the control pig 1 of lot X may possibly have been due to the accident of injecting the virus into the lumen of the intestine, a danger which has been pointed out by Rosenau. But this accident could hardly have prevailed to an extent to account for the fact that in the total number of animals observed the average duration of life after inoculation was longer in pigs injected by the peritoneum than in those injected under the skin of the abdomen, an average period of about fifty-two days in the one case and sixty-three days in the other. Each animal was submitted to autopsy shortly after death and microscopic examination of the tissues was made in most cases.

A general tuberculosis but of very variable extent and intensity was found in every animal. Possibly a fairer test of the problem set ourselves would have been through an attempt to imitate normal modes of infection rather than by the massive injection of virulent bacilli; but it was assumed that relative resistance would be manifested in one case as in the other, and we feared to attempt to grade resistance by an estimate of induced tuberculosis in animals which might have had to be kept for many months.

A summary of our experiments and their results may be found in the accompanying table. The animals in each lot received identical treatment. Those in lots I to III were treated with tuberculin, "T. R;" in lots IV to VI with the watery extract from the Saranac Laboratory; lots III, VI and IX were normal pigs which had received no nasal instillation. They were given intravenous injections of tuberculin at the same time and of the same kind and amount as the lots of which they were controls.

Column 4 shows that each pig that had been treated by the nose received an intravenous injection of 0.25 cc. of the appropriate tuberculin, thirteen to sixteen days after the last nasal instillation. The following columns up to column 9 represent the results of successive intravenous injections and the amount of tuberculin used. In column 9 is noted the number of days elapsed between the last intravenous injection and the date of inoculation with virulent bacilli and the avenue of inoculation and the weight of each animal is given. Finally in column 10 is shown the number of days lived by each pig after inoculation and its weight at death. As is represented in columns 4 to 8,

note was made of the reaction manifested by each animal following the intravenous injections. All animals in each lot are numbered individually, 1, 2, 3, etc. The absence of anaphylactic reaction is represented by the negative sign −.

Being accustomed to witness the symptoms of serum anaphylaxis we were surprised at the slight degrees of disturbance following toxic injections of the tuberculins. In conducting the injection, the animals were lightly etherized and fastened on a holder. An average of about three minutes elapsed between the time of insertion of the needle in the jugular vein and release of the animal from the holder after sewing up the incision in the skin. The injections were made slowly through twenty to fifty seconds, according to the amount of fluid introduced. After release from the holder most of the animals when laid on the side sat up at once, showing only more or less muscular weakness. In the tables the reactions of these are recorded thus, −. Some continued to lie on the side for several minutes, usually with increased vigor of respiration. These are recorded as + as regards reaction. When the respiratory disturbance and shock were pronounced the reaction was recorded as ++. In only one case, that of pig 4 of lot I, at the first intravenous injection, was there striking resemblance to the anaphylactic seizures familiar in serum pigs, expecially such as have had portions of brain removed. This pig lay upon its side with scratching and tetanoid movements of the legs, but it sat up in good condition after five minutes. With such slight reactions as we have described it is often difficult to be sure that the phenomena are not, as it were, artifact rather than anaphylactic.

Inspection of column 4 shows that, at least as regards lots I and IV, there was sufficient anaphylactic demonstration to indicate that there had been absorption of and sensitization by tuberculin by the preceding nasal instillations. It is curious that the reactions in each case were limited to pigs which had received the smaller doses, 0.04 cc., by nasal instillation. We were surprised to find, as shown in columns 5 and 6 of lot VI, no evidence of sensitization through the intravenous injection of the Saranac watery extract, contrary to the finding of Baldwin by other methods.

As regards the vital influence of the tuberculin injections, most pigs gained weight and remained well. To this rule there were some exceptions; thus guinea-pig 3 of lot IX became partially paralyzed in the hind legs some forty days after its third intravenous injection, but recovered

| LOT | (1) NUMBER | (1) WEIGHT | (2) KIND OF TUBERCULIN | (3) PRELIMINARY NASAL INSTILLATIONS OF TUBERCULIN | (4) FIRST INTRAVENOUS INJECTION. TIME SINCE LAST TREATMENT. AMOUNT OF INJECTION | (5) SECOND INTRAVENOUS INJECTION. DAYS ELAPSING SINCE FIRST INTRAVENOUS INJECTION. AMOUNTS AND RESULTS |
|---|---|---|---|---|---|---|
| | | *grams* | | | | |
| I | 1<br>2<br>3<br>4 | 155<br>155<br>155<br>155 | T. R. each cubic centimeter containing 2 mgm. dry substance | Nasal instillation every fourth day with 0.04 cc. Five doses | 16 days<br>0.25 cc. intravenous<br>Results<br>−<br>−?<br>+<br>+ | 14 days<br>0.25 cc. intravenous<br>+<br>+<br>+<br>+? |
| II | 1<br>2<br>3<br>4 | 155<br>175<br>150<br>125 | T. R. | Same as lot I, but each instillation contains 0.1 cc. | 16 days<br>0.25 cc. intravenous<br>Results<br>−?<br>−<br>−<br>− | 14 days<br>0.25 cc. intravenous<br>+<br>+<br>−<br>− |
| III | 1<br>2<br>3 | 300<br>305<br>335<br>These weights were taken at time of first intravenous injection. | T. R. | Controls. No nasal treatment | None<br>0.25 cc. intravenous<br>Results<br>−<br>−<br>− | 14 days<br>0.25 cc. intravenous<br>+?<br>+<br>+? |
| IV | 1<br>2<br>3<br>4 | 210<br>215<br>210<br>215 | Filtered water extract of tubercle bacilli. Each cubic centimeter containing 1.1 mg. dry substance | Nasal instillation every second day of 0.04 cc. Six doses | 16 days<br>0.25 cc. intravenous<br>Results<br>+?<br>−<br>+<br>+? | 14 days<br>0.25 cc. intravenous<br>−<br>−<br>−?<br>+ |
| V | 1<br>2<br>3<br>4 | 215<br>240<br>240<br>210 | Same water extract of tubercle bacilli | Same as lot IV, except each instillation contains 0.1 cc. | 16 days<br>0.25 cc. intravenous<br>Results<br>−<br>−<br>−<br>− | 14 days<br>0.25 cc. intravenous<br>+?<br>+?<br>−<br>− |
| VI | 1<br>2<br>3 | 480<br>425<br>395<br>Weights at time of first intravenous injection. | Water extract of tubercle bacilli | Controls. No nasal treatment | None<br>0.25 cc. intravenous<br>Results<br>−<br>−<br>− | 14 days<br>0.25 to 0.38 cc. intravenous<br>−<br>−<br>− |
| VII | 1<br>2<br>3<br>4 | 155<br>155<br>185<br>125 | B. E. each cubic centimeter contains 10 mgm. dry substance | Nasal instillation every fourth day with 0.04 cc. B. E. six times | 13 days<br>0.25 cc. intravenous<br>+?<br>−?<br>−<br>− | 21 days<br>0.5 to 0.63 cc.<br>+?<br>+?<br>−?<br>+? |
| VIII | 1<br>2<br>3<br>4 | 185<br>185<br>185<br>185 | Same B. E. | Same as lot VII but instillation increased to 0.1 cc. | 13 days<br>0.25 cc. intravenous<br>−<br>−<br>−<br>− | 21 days<br>0.44 to 0.5 cc.<br>+?<br>−?<br>+?<br>−? |
| IX | 1<br>2<br>3<br>4 | 485<br>480<br>450<br>Weights taken at first intravenous injection. | Same B. E. | Controls. No nasal treatment | None<br>0.25 to 0.32 cc.<br>−?<br>+?<br>− | 21 days<br>0.63 cc. intravenous<br>+<br>−?<br>+? |
| X | 1<br>2<br>3<br>4<br>5<br>6<br>7<br>8<br>9<br>10<br>11 | 695<br>545<br>525<br>765<br>715<br>630<br>455<br>350<br>480<br>540<br>615<br>Weights taken at time of inoculation. | Final controls, normal guinea pigs. No tuberculin used | | | |

| (6) | (7) | (8) | (9) | (10) | |
|---|---|---|---|---|---|
| THIRD INTRAVENOUS INJECTION. DAYS ELAPSING SINCE LAST INJECTION. AMOUNTS OF INJECTION AND RESULTS | FOURTH INTRAVENOUS INJECTION. DAYS ELAPSING SINCE LAST INJECTION. AMOUNTS OF INJECTION AND RESULTS. | FIFTH INTRAVENOUS INJECTION. DAYS ELAPSING SINCE LAST INJECTION. AMOUNTS OF INJECTION AND RESULTS | INOCULATION WITH VIRULENT TUBERCLE BACILLI. DAYS SINCE LAST INTRAVENOUS INJECTION. SITE INOCULATED AND WEIGHTS OF PIGS | NUMBER OF DAYS LIVED AFTER INOCULATION. WEIGHTS AT DEATH | |
| | | | | Days lived | Weight |
| | | | | | *grams* |
| 21 days<br>0.005 cc. intravenous | 21 days<br>0.56 cc. intravenous | | 112 days | | |
| − | −? | | Subcutaneous, 765 gms. | 32 | 480 |
| − | − | | Subcutaneous, 900 gms. | 21 | 535 |
| − | + | | Intraperitoneal, 960 gms. | 36 | 555 |
| +? | − | | Intraperitoneal, 945 gms. | 34 | 570 |
| 21 days<br>0.005 cc. intravenous | 21 days<br>0.56 to 0.81 cc. | | 112 days | | |
| +? | − | | Intraperitoneal, 915 gms. | 59 | 620 |
| ++ | − | | Subcutaneous, 420 gms. | 24 | 340 |
| − | − | | Intraperitoneal, 1065 gms. | 67 | 520 |
| − | − | | Subcutaneous, 1005 gms. | 53 | 530 |
| 21 days<br>0.005 cc. intravenous | 21 days<br>0.65 to 1.25 cc. | | 112 days | | |
| − | + | | Intraperitoneal, 765 gms. | 55 | 510 |
| − | + | | Subcutaneous, 755 gms. | 66 | 515 |
| +? | ++ | | | | |
| | Pig 2 died 49 days later | | | | |
| 21 days<br>0.5 to 0.69 cc. | 14 days<br>1.00 cc. intravenous | 14 days<br>1.00 cc. intravenous | 56 days | | |
| − | +? | − | Intraperitoneal, 785 gms. | 36 | 490 |
| − | − | − | Subcutaneous, 755 gms. | 36 | 450 |
| −? | + | − | Subcutaneous, 725 gms. | 67 | 385 |
| + | + | +? | | | |
| | | Pig 2 died 48 days later | | | |
| 21 days<br>0.5 to 0.63 cc. | 14 days<br>1.00 cc. intravenous | 14 days<br>1.00 cc. intravenous | 56 days | | |
| +? | + | + | Subcutaneous, 600 gms. | 61 | ? |
| −? | + | −? | Subcutaneous, 690 gms. | 39 | 437 |
| − | + | − | Intraperitoneal, 750 gms. | 53 | 410 |
| − | ++ | + | | | |
| | | Pig 3 died 14 days later | | | |
| 21 days<br>0.38 to 0.64 cc | 14 days<br>1.00 to 1.1 cc. intravenous | 14 days<br>1.00 cc. intravenous | 56 days | | |
| − | + | + | Intraperitoneal, 810 gms. | 85 | 515 |
| − | −? | +? | Subcutaneous, 575 gms. | 90 | 465 |
| − | −? | +? | Subcutaneous, 805 gms. | 47 | 490 |
| 14 days<br>0.75 to 0.81 cc. | | | 63 days | | |
| +? | | | Subcutaneous, 750 gms. | 21 | ? |
| + | | | Intraperitoneal, 755 gms. | 51 | 620 |
| −? | | | Subcutaneous, 745 gms. | 44 | 420 |
| + | | | Intraperitoneal, 815 gms. | 49 | ? |
| 14 days<br>0.75 to 0.81 cc. | | | 63 days | | |
| +? | | | Intraperitoneal, 875 gms. | 59 | 445 |
| + | | | Subcutaneous, 805 gms. | 54 | 500 |
| +? | | | Subcutaneous, 725 gms. | 76 | 395 |
| +? | | | Intraperitoneal, 726 gms. | 68 | 516 |
| 14 days<br>0.82 to 1.00 cc. | | | 63 days | | |
| − | | | Intraperitoneal, 865 gms. | 69 | 530 |
| − | | | Subcutaneous, 840 gms. | 105 | 570 |
| − | | | Subcutaneous, 785 gms. | 73 | 515 |
| Pig 3 had a temporary paralysis after 44 days | | | | | |
| | | | Normal pigs numbers 1 to 8 inoculated with virulent tuberculosis on November 19, as controls for lots IV, to IX. All other pigs inoculated December 10. | | |
| | | | Intraperitoneal, 695 gms. | 115 | 470 |
| | | | Subcutaneous, 545 gms. | 67 | 520 |
| | | | Subcutaneous, 525 gms. | 46 | 315 |
| | | | Intraperitoneal, 765 gms. | 69 | 485 |
| | | | Intraperitoneal, 715 gms. | 76 | 510 |
| | | | Subcutaneous, 630 gms. | 52 | 425 |
| | | | Subcutaneous, 455 gms. | 41 | 365 |
| | | | Subcutaneous, 350 gms. | 31 | 305 |
| | | | Subcutaneous, 480 gms. | 23 | 320 |
| | | | Subcutaneous, 540 gms. | 38 | 450 |
| | | | Intraperitoneal, 615 gms. | 24 | 375 |

before the final inoculation. Guinea pig 2 of lot II gained weight more slowly than its companions during the treatments and lost weight steadily after the last intravenous injection.

Pigs 2 of lot IV and 3 of lot V died forty-eight and fourteen days after their fifth intravenous injection. On autopsy the former showed yellowish areas through the heart, kidneys and suprarenals and the latter had the signs of broncho-pneumonia. We must suspect some specifically deleterious influence in the tuberculin poisons, since of several hundreds of guinea-pigs treated in a similar manner with horse serum and kept under the same conditions, none had died.

A glance at column 10 of the table shows that of the group of guinea pigs treated with T. R., the members of lot I which received the smallest amount of tuberculin in the preliminary nasal instillations lived an average of only thirty-one days after being inoculated with virulent tubercle bacilli. The members of lot II, which had received the larger nasal installations, lived fifty-one days after inoculation, while the controls of lot III, which had received intravenous injections identical with the preceding but no nasal instillations, lived sixty-six days after inoculation.

Analogous results attended experiments with the watery extract and the B. E. With the former the duration of life after inoculation in the pigs receiving the small instillations was forty-six days, in those receiving the larger instillations it was fifty-one days and in those receiving only the intravenous injections it was seventy-four days.

The corresponding figures after use of the bacillary emulsion were forty-one, sixty-four and eighty-two days.

Finally, in group X, composed of normal guinea pigs, the average length of life after inoculation was fifty-three days, including pig 1 in which death was delayed for an exceptional period.

## SUMMARY

In evaluating the results of such experiments as have been described we are at the disadvantage of dealing with many factors whose nature and weight are beyond our knowledge. Nevertheless, if our final figures prove anything it is the exact opposite of what we set out to establish, namely that the spaced absorption of tiny quantities of tuberculo-protein by the nose might induce in guinea pigs an artificial resistance against inoculation tuberculosis. That a slight but positive

degree of sensitization to tuberculo-protein can be induced, even by instilling it into the nose, is shown in the text. The anaphylactic symptoms elicited by us seem decidedly less striking than those obtained by Baldwin.

Three preparations of tuberculin, a Berkefeld-filtered watery extract and two emulsions of ground bacilli of different concentrations were used upon three groups of guinea pigs.

After a preliminary course of tuberculin instillations by the nose each group of treated pigs, together with a number of normal animals, was given a series of spaced intravenous injections with the corresponding tuberculin. At intervals of fifty-six and one hundred and twelve days after the last intravenous injection all animals were inoculated with a culture of virulent tubercle bacilli. For each form of tuberculin used in the preparatory treatment the average duration of life after inoculation with the living germs was decidedly less in animals which, in addition to the spaced intravenous injections, had undergone a course of nasal instillation than in those (controls) which had suffered intravenous injections alone.

Strange to say, also, the duration of life was shorter in pigs which had received the smaller quantities of tuberculin by the nose than in those which had received the larger. Compared with normal animals inoculated with tubercle bacilli without previous treatment (final controls) the resistance of the instilled pigs was unchanged or slightly lowered, while that of those which had received intravenous injections of tuberculin without previous instillation was somewhat decidedly raised.

So far as these experiments go they point to the conclusions that the influence of absorption of small quantities of tuberculin by the nose followed by a series of spaced intravenous injections either does not change or slightly lowers the normal resistance of guinea pigs towards tuberculosis, while the intravenous injections alone, without preliminary instillation, rather decidedly raises resistance.

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# UNDERGRADUATE INSTRUCTION IN TUBERCULOSIS[1]

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I should like to make a thorough investigation of undergraduate instruction in tuberculosis because I think the subject deserves it and demands it. But the limits of this paper forbid this. I shall therefore confine myself to the exposition of a few matters as I see them, imperfectly perhaps, incompletely and with no gray hairs of experience behind me, yet withal, with honesty I trust and a consuming desire to help and do my share.

Tuberculosis teaching in our medical schools is an unsolved problem. It demands attention and more active consideration than the passing of resolutions in committee meetings. I believe its solution to be the most pressing one before us to-day. Have you ever stopped for a moment to consider what it would mean if every year every one of our several thousand graduates in medicine left school with some interest in tuberculosis, with some idea of how to make a diagnosis, with some judgment of what to do with the patient once he labelled him? What do you think would be the situation if fifty years from now every practising physician appreciated the relations between infection and disease, the relative value of signs and symptoms, the importance of the practice of conservative medicine on those who reacted tuberculously but were not tuberculously ill—the pregnant woman, the man with a common cold, the child with measles, the patient about to undergo a serious surgical operation? What if in thinking of tuberculosis every physician's instinct immediately sensed curability of infection, arrest of disease and recrudescence of clinical arrest? What if his social sense at once responded to the fact that in nine cases out of ten tubercu osis bankrupts, that it leaves *young* widows with *young* children, that its victims spread infection for years as against the months of the syphilitic, that syphilis hampers while tuberculosis disables, that cancer

[1]Read before the Clinical Section of the Thirteenth Annual Meeting of the National Association for the Study and Prevention of Tuberculosis, Cincinnati, Ohio, May 11, 1917.

meets the man after he has arrived, while tuberculosis strikes him down as he begins the race? What if throughout the land we had all these men, these foci, who have real knowledge and therefore real interest, who have their fortuned patients and their honest derelicts, in whom the rich confide and on whom the poor depend, who could so well arouse Dives to come to the aid of Lazarus? All this is common knowledge among specialists. Can it not be made availabe to our students?

It can. The material to work on is at hand in every medical school where the student can get a glimpse at the sick and the dead, at the autopsy table and the microscope. Everwhere there is the person who harbors tubercle yet is not ill with tuberculosis, the man who runs the gamut of physical examination before a diagnosis of tuberculosis can be accepted or ruled out, the consumptive who makes his own diagnosis. Everywhere there is the patient whose management you must arrange, the man who once had tuberculosis but who is now well rid of it, the "cure" who returns, again broken down and discouraged. In every clinic, no matter how primitive, you will see the face tighten and you will listen to the despairing tones as you give your opinion, to the story of the lost livelihood, of the dependent relatives, of the black economic outlook. No medical school can say that it is too poor to teach tuberculosis. It can no more escape the ubiquity of the tubercle bacillus than can the cabin in the city alley.

Now it has been said that even although the facilities to teach tuberculosis are given, the medical student has no interest in the subject and cannot be interested. This I do not believe and I cannot help thinking that the affirmation too often shifts the burden of reproach from the teacher where it belongs, to the student. It cannot be denied that the American medical student is awake to everything that is interesting or is presented in an interesting manner. Nor can it be gainsaid that nothing so lends itself to lively and living exposition as tuberculosis. Of course, a good deal depends on what we mean by tuberculosis. A drab, relentless routine of percussion of pale and sickly patients and of sentence to the same grind of treatment will no doubt discourage many a student and leave him cold. But tuberculosis as a subject for study, as a subject for teaching,—what more can any man want? Tell me anything that offers so great and so unique an opportunity to both student and teacher as tuberculosis, which ever since men began to live together has entered so largely, so intimately, so

dreadfully into their lives. Tuberculosis: a disease of every part of the earth, of every historical era, and of every race; a disease of infancy, of adolescence and of old age; a disease that exerts its effects on every organ and tissue of the body, that may be isolated or may be widespread or may take on almost every conceivable combination; that may come like the lightning stroke or more insidiously than the advance of age itself; that may kill in a week or drag out its career through a normal life span, a lazy career perhaps, perhaps a checkered one, but never a colorless one; a disease too whose active cause is known and is scarcely less interesting or less versatile than the effects it produces—how wonderful is this trinity of bacilli, human, bovine, avian, so like and yet so unlike, how wonderful their less combative cousins, the saprophytic acid-facts! And if we would go on and enumerate other attributes,—the universality of infection, the indifference of the germ to the portal of entry available, its armor against the body's weapons, its habits of hibernation and rejuvenescence, its triumphs as we read the roll of victims—and there are both quantity and quality there—and as we proclaim it captain of the hosts of crushed ambition and of death; when we consider the imitations of almost every other malady that it paints and how it leads us through the realms of all medicine if we would tag it; when, in addition, we consider how often and how much it leans on other diseases and on the habits and constitution of man to exert its effects, then we would ask, "What then would a man rather study, what rather teach than tuberculosis?" Laennec and Louis and Virchow and Cohnheim and Austin Flint and Trudeau are inspiring enough and good enough company for any man.

In planning tuberculosis teaching there will probably never be complete agreement of opinion as to the curriculum and the personnel of the teaching staff. It is only natural that the dispensary, the wards of the general hospital, the laboratory or the sanatorium, in turn, should be emphasized by men whose interests and activities lie in any particular field. Tuberculosis itself is breaking up into a number of specialties and the men who single handed can present the subject in an adequate and well rounded manner are very few indeed. There are those who look upon the diagnosis of early disease as the heart of our present problem. There are others who believe systematic segregation of the open case to be the essential point of attack. There are some who declare frankly that there can be no solution until the discovery of some therapeutic agent that will cure practically every variety of case.

There are not a few who are convinced that at bottom the problem is an extra-medical one, that its roots are embedded and flourish in the bed rock and top soil of our present day civilization which is the flower of ages of evolution and social conventions and that nothing less than a slow, laborious and complete revolution or development of social habits and customs can effect a radical change in the situation. In our dilemma it is likely that, as always, truth is many sided and that no one man nor group of men has a monoply of wisdom, and that if we are to impart our available information to our students we must correlate in a practical way the abilities and efforts of a number of men working in particular fields.

This you will say, is nothing else than a repetition of a general medical course applied to a special subject and involves more time than can be devoted by the medical undergraduate. It is indeed a wheel within a wheel and for a few minutes I wish to detail how such a plan is feasible and practical. And understand that since I believe that tuberculosis will play a larger part in a practitioner's professional life than any other disease, I do not think that we need be backward in asking our medical faculties for all the time that they can allot to the subject.

As matters stand now, the student, even though no formal course in tuberculosis is offered, really sees a good deal of tuberculosis and hears a good deal about it during his four years in medical school. During his course in pathology and in every general and special clinic he sees a variety of tuberculous conditions and hears their nature, their diagnosis and their treatment discussed. But as a rule they are here presented as incidents, as isolated and individual affections, and except by the unusual man their broader aspects, their relations and their points of contact and contrast as regards tuberculosis at various ages, locations, time of infection, immediate cause of disease, etc., are scarcely touched upon. In the general and special clinic tuberculosis is taken up in an incidental and not a systematic manner. It is an occurrence that flashes across every day's routine and is very properly handled as such. The result is that the student picks up some very valuable points of diagnosis and, if he is receptive, carries away the accepted method of treatment. But his idea of tuberculosis is not enlarged and he may see hundreds of cases without getting the first fundamental conception of the life history of the individual case (not patient) of tuberculosis, the conception that in almost every instance clinical tu-

berculosis is the fruition of a seed implanted in the obscure past, nourished, blighted and again nourished by all the vital incidents that have entered into the physical life of the individual.

It is of the utmost importance, however, that the internist, the surgeon, the laryngologist, the pediatrician, the orthopedist, the urologist, continues to teach tuberculosis as he is doing at present. But it is very necessary that we supplement this instruction by some systematic and correlated course in tuberculosis: a course that is all tuberculosis, that selects its material from the other fields of medicine and weaves it all into an orderly, consistent fabric, the warp and woof of which are tuberculosis, the technical threads of which are refined and polished and the cloth ready to be made into a fit garment when the occasion arises.

Such a course should aim to interpret and correlate systematically all that the student has seen or is likely to see in his contact with all kinds of tuberculous patients. Besides this it must be based on a clear idea of what the requirements of the situation are, what is most worth while to the student and what will most contribute to the advancement of the antituberculosis movement. It must not spend itself in an aimless recital of physical signs and symptoms and of the management of the patient. It must have a proper sense of proportion and proceed along lines that take into account the relative weight and emphasis to be given to the various phases of what has come to be known as the tuberculosis problem.

Fully aware that I at once lay myself open to contradiction and disagreement I would enumerate in the order of their relative importance the things that should be taught the student, as follows: first, the importance of NOT making a diagnosis of tuberculosis; second, some rational idea of what to do with the patient once he has been called tuberculous; third, the relapsing nature of the malady; fourth, some conception of the relative value of signs and symptoms in evaluating the individual case and a firm and lasting impression that no disease is quite so notorious as tuberculosis in disharmony of anatomic change, physical signs and symptoms; fifth, the fact that every tuberculous patient must be handled strictly as a personal entity and his course directed only after full and complete knowledge of his family, social and economic conditions; sixth, the technique of making a diagnosis. You will at once see that several of these phases cannot be sharply cut off one from the other and that they overlap. I assume that the student has had an

elementary course in general pathology and that he has had bred into him the habit of applying his pathological senses to all clinical manifestations that he may encounter although here also I would take up tuberculosis in its special manifestations. If you will refer to the list that I have just outlined I believe that you will agree that in general its arrangement corresponds with the difficulty and length of time it took us to acquire our own experience of any particular aspect.

To put the matter briefly and sharply, our teaching problem is to give our students the broadest and most practical view of tuberculosis in the shortest possible time and with the least interference with his other courses. He must begin clinical acquaintance with the disease in his third year. He should receive instruction in it in connection with all his other clinical courses for this will constantly breed into him the instinct of the universality and the innumerable ramifications of tuberculosis. He should in addition be given the opportunity to study tuberculosis in a formal and well formulated manner and be taught by men whose experience has shown them what to present and how to present it. The material to work on is everywhere abundant, but in too many places the necessary organization and facilities are lacking.

The necessary tools are a tuberculosis dispensary, an adequate laboratory (though it is remarkable how much can be accomplished with a thermostat, a centrifuge and a modicum of glassware), and an able and enthusiastic teaching force. A most helpful adjuvant is a tuberculosis ward. I do not, however, consider the ward as necessary to the undergraduate student, though it may be very valuable to the teacher and advanced student. The first and main impression that the beginning student of tuberculosis should get is the right impression, and to get the right impression of tuberculosis one must become familiar with it in its environment. I would therefore recommend that the student do a certain amount of out patient work; in fact, I consider this almost necessary for a proper appreciation of the disease. I cannot see how the undergraduate will pick up in the tuberculosis ward anything of prime importance that he cannot just as well get in the dispensary or in the home. As a matter of fact too much acquaintance with ward patients at the beginning may give him the wrong impression, for here he would work only with diagnosed patients and the consumptive lying in a clean bed in a bright room and receiving the best of care is not the usual picture of the disease.

In the dispensary, of course, the student will first meet the man who

walks in because he isn't feeling just as he should. He will form his acquaintance and listen to his story and record it. He will be taught the great importance of a medical and social history, particularly in such a patient. He will make a physical examination of the man and record what he has found. In company with the dispensary physician and teacher he will study the case. He will be intensively instructed in the technique and mechanics of physical diagnosis. He will take the patient's sputum and other specimens to the laboratory and examine these himself. He will look into the patient's home life and occupation or will have these reported to him by the dispensary nurse. He will discuss the patient's management with the dispensary physician and here we shall leave the individual student for a while.

To get the best results, results that are best for the student, teacher and patient, only a few students, three or four, should work in the ordinary dispensary at a time. But matters should be so arranged that every student spends at least thirty-two hours, that is, two hours a day twice a week for eight weeks, in the dispensary. In this time he can fall in with a good variety of patients and can acquire some slight facility in percussion and auscultation of the chest. He should at least have acquired some sense of his own limitations. And this leads me to the matter of diagnosis in general and of early diagnosis in particular.

I won't say that the majority, but I will say that many cases of pulmonary tuberculosis need no physical examination for diagnosis. As a rule the patient's associates at home can diagnose what we call consumption. In a great many other cases sputum examination (and it is not practised enough or often until days and perhaps weeks have been spent in elaborate chest examinations) will proclaim the condition. But it is remarkable how much scolding we physicians have had from extremists of the early diagnosis school. We would almost gather from some brochures that if he had been alert enough and keen enough and not too ignorant every physician might have saved every consumptive's life had he picked up the disease at its first flicker. I realize that the purpose of these propagandists is most worthy though I do not believe that early diagnosis deserves the importance in the tuberculosis firmament that some would give it. Trying my best to know and understand conditions that exist I consider it only a minor arm of the service in our battle. All this when I realize that in so many instances patients with insidious tuberculosis first consult the physician only after the malady is well expressed and that in so many others the disease begins

abruptly and acutely in a way that cannot be considered incipient in point of extent of lesion and symptoms.

Now just because of this warped and narrow vision of tuberculosis it has come about that in his course the student only too often has got the idea that the detection of the ultimate râle is about all there is to tuberculosis and he promptly proceeds to polish off his technique so that he can compete in the game. He has also heard of milk and eggs, and equipped with the knowledge that persistent, localized râles after coughing so often mean tuberculosis and with a hazy belief in the potency of milk and eggs, and profoundly ignorant that there are things like symptoms and medical history and individual habits to be considered he goes out to snare his tuberculous patients. This is the situation that I protest and I do it with the fullest respect for early diagnosis in its place and believe absolutely that training and proficiency in physical examination is the very corner stone of medical diagnosis. But I sometimes wonder whether all the tragedies resulting from failure to diagnose early have not been more than atoned for by the tragedies of a false diagnosis of tuberculosis. Therefore the first deep tract that I would lay down in the student's brain is one that ever warns him never to make a diagnosis of pulmonary tuberculosis unless he can prove it. He may have his opinion and he may have his patient undergo what is substantially treatment for tuberculosis, but he should not voice a flat opinion to the patient nor should he send him to a tuberculosis resort.

All this analysis of history and signs and symptoms can be taken up in the dispensary with the student who should not leave medical school without acquiring a sense of proportion that is well balanced and which he can put into practice. It is in the dispensary that the student must get method and data and some point of view. But in addition to this he must have his point of view clarified, broadened and well grounded.

This enlargement and strenthening of vision is to be done by clinics and by lectures. In eight or nine clinics and ten or a dozen lectures a great deal can be accomplished. The clinics should be well ordered and proceed from one to the other in a developmental manner. Not too much emphasis should be paid to the eliciting of signs as these can be best worked over in the dispensary. But an effort should be made to present as many people as possible to the student and in an interesting manner to recite the past and present history of these people. Beginning with a display of children whose skins do not react to tuberculin

we can then show some that do but who have never had clinical tuberculosis. We can then go on to those who are now in the best of health but who have a history of one or more attacks behind them. We can exhibit children who are for the time being ill with tuberculosis. We can meanwhile take the opportunity to discuss contact, methods of infection, latency, types of disease, and in general contrast the situation in the child with that in the adult.

Our next clinics would take up the adult. Pulmonary disease is now the type. We may present healthy men who have put severe disease behind them. We show acute tuberculosis and chronic tuberculosis and the combinations of these. We show the disease that began with haemoptysis, that with onset with cough and expectoration or with pain or with transient, daily lassitude. We discuss the significance of symptoms, the technique of laboratory diagnosis, the balancing of history and signs and symptoms, the amelioration of symptoms, the relapse after arrest, the method of treatment and the ultimate prognosis. All these nine clinics should be so arranged that beginning at the first clinic with infection without clinical disease in the child we proceed step by step to a demonstration of prognosis in the adult and prophylaxis in the last clinic. And throughout all of them an effort should be made to bring into harmony what the student has seen in the other services of the hospital and to give each manifestation its proper place.

The student is now ready to take up tuberculosis in its broadest aspects. Following the clinics he should be given a course of about a dozen lectures that would deal with such matters as the pathology of tuberculosis, the place of the disease in the history of medicine, the history and attributes of the tubercle bacillus, the factors that influence infection, the development and effects of infection, the conversion of infection into disease, the spread and arrest of disease, the nature and effects of tuberculin, hypersensitiveness and immunity, therapy, prognosis, prophylaxis and the social side of tuberculosis. The aim of such lectures should be not so much to stress the obvious as to guide and arouse the student and to prepare him to handle his future acquaintance with tuberculosis in a rational and logical manner.

Now all of this dispensary, clinic and lecture instruction can be given during the third year with a maximum of about fifty hours of attendance. The dispensary work is mainly to develop method; the clinics and lectures are largely orienting and interpretative. The student goes to his work in the other services of the medical school immeasurably better

prepared to appreciate all the cases of tuberculous disease that he may encounter. Additional instruction that might be arranged would be joint clinics held by the teacher of tuberculosis and the pediatrician, the orthopedist, the laryngologist, the ophthalmologist, the Roentgenologist or the surgeon. That such a course in tuberculosis is not an unattainable ideal is evidenced by the fact that it is to-day being carried out in most of its details in one of our medical schools.

Besides the required work that has been above outlined other opportunities should be offered those students who have the time and inclination to make use of them. In the laboratory there should always be a few desks available where the selected fourth year student can begin the study of the special bacteriology, serology and clinical microscopy of tuberculosis and can take up the simpler methods of animal experimentation. Such elective courses are, however, hardly worth while unless the student's course is so arranged that he can devote three or four consecutive hours a day two or three times a week over a period of one third of the scholastic year. Unless the laboratory facilities are very unusual not more than two or three students a year should be allowed to elect such work.

The out patient work of the dispensary is capable of great development and should be utilized to better advantage. It is of the utmost importance that we devise some method whereby the student can get a consecutive view of the progress of a case of tuberculosis. In no other way will he have quite so good an opportunity to become familiar with and gain an appreciation of the ups and downs of the average patient. If he can follow intimately one or several cases over a period of months or a year or two he will gain a valuable and lasting impression of the pendulum like progress and decline of the ordinary tuberculous patient and under proper guidance may learn lessons that otherwise it might take him years to acquire in practice. We have therefore called for volunteers from our third year students who for the remainder of their medical course pledge themselves to visit dispensary and discharged sanatorium patients. We plan to have them undertake toward these patients the shadow or even the reality of the family physician. They will be under the supervision and guidance of the dispensary physicians and the visiting nurse. We aim to emphasize the human relation between attendant and patient. We put the matter to the patient frankly: we want to help him, we are not planning to do any detective work, we want to prevent relapse, we are trying to give him a better chance

of ultimate and lasting recovery from his disease, we want him to make a friend and a confidant of our student. The student on his side now has a rare opportunity to learn a great deal about real tuberculosis and, as he frequents the home of the dispensary patient, he also begins to learn something about the ultimate problem of the conquest of tuberculosis, something that makes a lasting impression and which will give him no small impetus when he begins his medical practice. We for our part can keep better track of some of our dispensary patients and can do a good deal of social service work at a minimum of expense. While the details of this plan have not been worked out I am confident that it is workable and that it is capable of great development. I am also sure that there will be no dearth of volunteers from the student body.

In the dispensary work the effort should be made to give the student as intensive a training in physical diagnosis as the time and the facilities allow. But it is obvious that even under the best conditions the student cannot become a finished examiner with thirty-two hours of work. As in everything else the only way to learn physical examination is to practise it and it is highly desirable that some arrangement be made whereby the student who desires to go further into tuberculosis will have the chance to work among large numbers of patients. In this connection a ward in the hospital would be valuable, for here several advanced undergraduates might always have the opportunity to perfect themselves in physical diagnosis. But it seems to me that a better plan would be to enlist the coöperation of the tuberculosis sanatoria.

It has been frequently stated that the medical staffs of our sanatoria are undermanned and that it is difficult to interest in this work men who have not had tuberculosis themselves. Why would it not be a good plan for the sanatoria to use our third and fourth year students as clinical clerks or internes during the summer vacations? For three or four months the student would be assisting in the institutional work. He would make frequent examinations of a great many patients of various types. He could do part of the clinical laboratory work and sometimes carry on a small piece of original research. He would relieve the permanent resident staff of a great deal of routine work and thus give the residents more time for study and investigation. He would himself be gradually absorbing a point of view of tuberculosis that he could get in no other way and learn much about the systematic and disciplinary treatment of the tuberculous. At the same time the ambitious student, worn perhaps after a year's hard work in the medical

school, would be supplementing his course in surroundings that would be attractive and would physically benefit him more than the same length of time spent in the hot and dusty city. The sanatorium is bound to get a good deal from the student but it must also give something in return. It should provide full maintenance for the student. It must not make an orderly out of him, nor simply fill his day's routine with mere drudgery that the residents are glad to be rid of. As a rule the student will come, ready to work and very anxious to learn. The sanatorium must take enough personal interest in him to see to it that he is taught. This plan is already being tried by Dr. D. A. Stewart of Manitoba and I believe it capable of great development. To be most effective it should be used as advanced training, that is, for those students who have already had some clinical experience and formal instruction in tuberculosis. It should be for the man who elects it, the man who shows a voluntary interest in the subject.

This sketch of a course of instruction in tuberculosis has been evolved with but one idea in view. It aims to be practical, to make use of conditions such as exist at most medical centers. If any particular clinic is blessed with ideal equipment and facilities, then that is another matter and we would outline what might perhaps be an ideal course. But I think that it is a great mistake to wait for the arrival of big things before attempting to do anything and in an organized and systematic manner making use of what is at hand. The use of dispensary patients, a small clinical laboratory, coöperation with other services and with tuberculosis sanatoria, and ambitious and interested teachers are I believe attainable anywhere and we of the National Association should make it our business to convince our general medical faculties of this fact.

We too must use our best efforts to arouse those whose special interests lie in other fields of medicine to the importance of the study of tuberculosis. We must show them that *we* believe that tuberculosis is vastly more than a particular affection of the lungs. We must do our work so that no orthopedist, no pediatrician, no urologist can afford to neglect it. We can learn much from them if we indicate to them research problems in their particular branches on which they can profitably work. But we should go about this, interested not too obtrusively in the National Association as such but with our energies wholeheartedly given to tuberculosis.

# MEDICAL NOTES, ABSTRACTS AND REVIEWS

It will be the eventual purpose of the REVIEW thoroughly to canvass all literature on tuberculosis as it appears in other medical periodicals and to present it in abstract form. Authors are requested to send abstracts or reprints of their papers to the Abstract Editor, Dr. George Mannheimer, 41 West 51st Street, New York, N. Y. In the present number many of the abstracts have been taken from other medical publications, such as the Journal of the American Medical Association, the Medical Record, the New York Medical Journal, etc., to whom acknowledgment is due.

**Artificial Heliotherapy.**—Is sunlight or heliotherapy of real value in medicine? This question has been pretty conclusively answered in the affirmative. It appears that the live agent or active principle in producing the good results is the action of the blue rays in producing a pigmentation of the skin, the pigment then in some manner becoming a circulating metabolic rectifier. Thus in Switzerland it has been noted that tuberculous patients recovered, and that their prognosis varied with the rapidity and ease of pigmentation of their skins.

If blue light is the active agent, it follows that any method which delivers blue light to the skin is a valuable substitute for heliotherapy, the more so as any electrical method is always available, whereas the sun at most is available only at certain hours, even when not obscured by smoke, fog, or clouds.

It is known that the mercury-vapor arc generates plenty of short-length actinic rays. It is also known that quartz is a substance, and one of the very few, not opaque to the blue rays. It is, therefore, theoretically possible to produce a light which will deliver at the skin blue light not associated with excessive heat.

To produce pigmentation is to reproduce the effect and to promise the results of which actual sunlight is capable. The only question remaining, therefore, before being forced to admit the value of such a lamp, is whether it really does produce in action a rapid pigmentation of the skin exposed to its rays.

Employed in connection with graduated heat from incandescent carbon filaments, as a metabolic stimulant for asthenic chronic intestinal cases, it has been clearly demonstrated that the light of this lamp actually does produce very rapidly a redness, even to blistering and peeling of the skin, and soon results in the acquisition of a pigmentation of the skin not to be distinguished from that obtained by much longer exposure to actual sunlight.

The lamp is, in fact, so active that a five minute exposure at a distance of a metre or so may result in a sensitive skin turning, as one patient expressed it, "as red as a lobster," by the end of twenty-four hours.

Since many patients will find it not only more convenient, but actually a saving of time, to have their skins tanned by artificial heliotherapy, in a quiet room, regardless of the time of day or night, and since it is proved that the lamp does produce the all-important pigmentation, it is suggested that the use of such an apparatus might to great advantage become more general, not only in private practice, but in hospital circles. Used rightly, such a lamp is certainly a powerful and valuable addition to therapeutic resources, as an easily available and ever ready substitute for actual heliotherapy. Its indications would seem to be those of sunlight itself.—*The Mercury Vapor Quartz Light a Valuable Therapeutic Agent, J. Bryant (Boston), Boston Med. and Surg. Jour., October 26, 1916.*

**Ultraviolet Rays from the Carbon Arc Light in Tuberculosis of Skin and Mucosae.**—Spitzer, the director of the Lupus Sanatorium, Vienna, has been using a modification of the Reyn arc light bath with remarkable results. Cases which failed to improve under other forms of light treatment, as well as x-rays and radium, have been cured with this apparatus. There is no longer any doubt that chemical rays from this source can exert a deep action. The total number of patients treated has been over 200, and the number of exposures was from 50 to 100, given daily. The amperage was 80 and the voltage 60. The earliest exposures are limited to 15 minutes, increased until at the fourth day they reach 60 minutes, at which duration they remain. That lupus of the skin should be bene-

fited is not strange, for that happens when the original Finsen-Reyn lamp is used. Far more impressive is the healing of all tuberculous lesions in the mouth, often in cachectic subjects who are perishing of inanition. Six cases which would have been classed as "inoperable" were readily cured. In several cases initial tuberculosis of the apex incidentally underwent resolution, a phenomenon not fully explained, but perhaps due to the general roborant effects of the light treatment.—*Uber Anwendung des Koplen-Bogenlichte bades bei primaires, und sekundärer Tuberkulose des Haut und Schleimhaute, L. Spitzer, Münch. Med. Woch., October 31, 1916.*

**Radiotherapy in Peripheral Tuberculous Adenopathy.**—By virtue of recent improvements in x-ray technic, through which treatment can be restricted largely to the more penetrating rays of short wavelength and much larger doses used without exciting dermatitis, there is now no form of tuberculous adenopathy in which x-ray treatment is not indicated. The x-rays melt down and cure the largest lymphatic masses, even without the aid of general treatment or heliotherapy; very rapidly when the glandular masses are semihard or recent, less rapidly but with equal certainty when they are hard and confluent. In closed suppurative cases, aspiration with a fine needle should preferably precede to remove the pus which forms an obstacle to the rays. In suppurating cases with sinuses and skin ulceration, the pus and necrotic tissue should likewise be withdrawn beforehand, the bridges of skin separating sinus openings sometimes cut through, and iodine applied from time to time to combat superadded infection. The x-rays remain, however, the main therapeutic factor. W. divides the skin over the affected glands in as many districts as are required, so that each unit of surface treated shall receive approximately the same dose of rays. Over each area hard rays are passed through a four mm. aluminum plate, measuring eight or nine on the Benoist radiochrometer. The sittings in each region are repeated until every portal of entry has received ten, twelve, or even fourteen H units of rays. The total amount is administered in five or six consecutive days. Marked reactions with high temperature do not follow such a procedure, except occasionally in certain soft, rapidly developing gland involvements. Neither is there ever noted a rapid growth of the lymphatic masses, or a general spread of the tuberculous process; such results as these, sometimes noted formerly, signify insufficient doses. W reports a number of cases, with photographic reproductions, illustrating the excellent results obtained from the use of rays in cervical adenitis.—*La Radiothérapie des adenopathies tuberculenses peripheriques, Albert Weil, Paris Medical, September 23, 1916.*

**Radiotherapy of Tuberculosis.**—Malmström has applied the mercury vapor light in over 100 cases of internal and external tuberculous processes, including 80 with pulmonary lesions. The entire body was exposed to the light for an hour every day or second day, commencing cautiously. No untoward by-effects were noted and the improvement in the general health was striking. Large tuberculous glands, with or without fistulas, subsided completely or leaving but slight relics. The fistulas healed without disfiguring scars. One empyema fistula, which had persisted for two years, healed over in three and a half months under the radiotherapy. Tuberculous processes in the larynx, bones and peritoneum, as also lupus, were cured or materially improved. He expatiates on the importance of radiotherapy with the sun, arc light or mercury light as a valuable adjuvant in combatting tuberculosis, and suggests that a course might be found useful as a preventive when the pleura or the glands at the hilus are affected. This might ward off secondary pulmonary tuberculosis.—*Radiotherapy of Tuberculosis with Mercury Vapor Light. (Om ljusbehandling mot tuberkulos.) V. Malmström, Hygiea LXXVIII, No. 18.*

**Salvarsan in Tuberculosis and Syphilis.**—The prompt employment of salvarsan or neo-salvarsan is indicated in latent, chronic and moderately active tuberculosis as soon as the nature of an added infection is diagnosed with reasonable probability to be syphilis, and whenever the history, signs or symptoms strongly suggest a previous luetic infection, particularly if such a patient is not improving upon the usually successful hygienic and climatic treatment of tuberculosis. But, active tuberculosis, acute tuberculosis, and diffuse miliary tuberculosis are usually contra-indications to the use of these preparations. There will be found patients belonging to the group of active and acute tuberculosis, who are also the subjects of lues, upon whom a small dose of salvarsan may well be tried and, unless followed by untoward results, cautiously repeated in gradually increasing doses.

When tuberculosis infects or becomes active in a patient with secondary, tertiary or even latent syphilis, the careful

employment of one of these drugs is also indicated.

The more active the tuberculosis, the smaller should be the initial dose; the slower its increase, the less frequent the interval, and the greater care and watchfulness required.

Tuberculin-like focal reactions may follow their administration, should be carefully watched for and if present, the location, intensity and character will frequently guide in the selection of the next appropriate dose or interval.—*Salvarsan in the Treatment of Double Infections, Tuberculosis and Syphilis, N. B. Potter, Amer. Jour. Med. Sciences, December, 1916.*

**Infrequency of Extrapulmonary Tuberculosis Under Tropical Sunlight.**—Steiner speaks only of Java, where he has practised for twenty years. Pulmonary tuberculosis is common enough, alike in the aborigines and various foreigners. No race or class has any immunity. But it is most rare to encounter white swelling of the knee, hip disease, scrofulous glands, scrofulous ophthalmia, etc. These conditions are the very ones which benefit by heliotherapy in the North. The Javanese live in almost perpetual sunshine, for in the rainy season the rain seldom appears before 4 p.m. Only the Europeans are protected from the solar light and heat, but these are lightly clad and partly exposed to solar rays; much more in fact than during the European summer, especially in childhood. The country is by no means salubrious, and typhoid, cholera, dysentery, ankylostomiasis, and malaria flourish. The bubonic plague has of late years become familiar. Cleanliness is hardly understood. The natives expectorate everywhere. Bathing is common but only as a refreshment. Food is ample—rice, fish, and legumes with not a little meat. The Europeans and Chinese seem alone in the use of alcohol. There is no milk industry. Cows' milk seems plentiful but is little used as a beverage, save by European children. It is by no means good milk, but can hardly contribute to the spread of pulmonary tuberculosis because of the absence of extrapulmonary forms which are usually associated with a possible bovine transmission. Whether or not the so-called scrofula is directly related to eventual pulmonary tuberculosis, every child (and nearly all are believed to have latent tuberculosis) ought to have the benefit of heliotherapy. During the warm months the skin should be exposed as much as possible to the sun—at least 50 per cent of the surface. The Javanese certainly gets plenty of fresh air, both because he is outdoors so much and because the loosely built houses are ventilated automatically. The inside air, however, is smoky and otherwise disagreeable. The frequency of pulmonary tuberculosis in Java may perhaps be accounted for by the lack of sanitary knowledge and by conditions like malaria and ankylostomiasis which tend to lower the general resistance.—*Tuberculose et solcit tropical, L. Steiner, Rev. Med. de la Suisse Rom., No. 10, October 20, 1916.*

**Exposure to Cold in Experimental Respiratory Infection.**—There is a widespread medical belief that exposure to cold is an important factor in the incidence of many diseases. Since the development of modern bacteriology the importance of this factor had gradually diminished and at the present time there is considerable difference of opinion as to whether such exposure plays any part whatever in the causation of disease. Experimental evidence is conflicting and as a great many of the animal experiments have been conducted with pneumococcus with which there has been considerable difficulty in producing experimental disease with regularity in animals, the results are not conclusive. The present experiments were carried out with rabbits inoculated with *bacillus bovisepticus*, which was an organism which caused the well known laboratory disease in rabbits commonly designated as "snuffles." It was selected for experiment because these conditions produced in rabbits were so similar to those caused by some of the respiratory infections in man, particularly pneumococcus, and because of the relative difficulty of producing pneumococcus pneumonia in rabbits. The experimental animals were kept in a warm temperature for periods of time varying from twenty-four hours to a week and were then inoculated by spraying the nose and throat with virulent cultures of the "snuffles" bacillus. They were then immediately chilled by exposing them to outside weather, the temperature of which was 45° F. and lower. The experiments were carried out in the winter of 1914 and 1915 and another series in the winter of 1915 and 1916. The totals for both series showed that of 37 experimental animals 15, or 40.5 per cent, reacted to the infection, while of an equal number of controls, nine, or 24.3 per cent, reacted. The striking difference between the two groups in the first year's experiments led very strongly to the belief that the exposure must be an important contributing factor. The second year's series, although a much smaller number, distinctly

modified the strength of this opinion, as an equal number of experimental and control rabbits reacted to infection in this series. Taking both series together, however, the conclusion seemed justified that exposure to cold after previous subjection to warm temperatures rendered rabbits somewhat more liable to infection with the *bacillus bovisepticus.—The effects of exposure to cold upon experimental infection of the respiratory tract, J. A. Miller and W. C. Noble, (New York), Jour. of Exper. Med., September, 1916.*

**Employment of Persons with Arrested Tuberculosis.**—A great deal of stress is put upon the danger of various occupations but very frequently little or no attention is paid to the housing and living conditions of the individual. It is folly to treat a man in a sanatorium for a year, then send him back to shop or office where everything is ideal from a hygienic standpoint and have him live in a home where conditions are most unhealthful. Our records show that there are a great many more housewives as patients than representatives of all the dusty trades put together. In sending patients back to work, they should be enjoined that they continue to obtain a maximum of rest. A patient taking up an outdoor job, where he is exposed to the elements, runs a 50 per cent greater risk of relapse than does the man who takes inside employment. The farm colony idea, this myth of light work, should have been exploded long before this, for the only thing light about the occupation of farming is the pay. The most logical plan is to send the patients back to their old occupations, where they will be assured of a larger income, where the mental strain will be less and where they will be working with people who will probably make things easier for them. It is desirable that they begin working on part time while being under medical supervision. The records of the Gaylord Farm for the past 12 years show that of the patients who returned to indoor employment, but 20 per cent had relapsed; of those who had returned to out-door employment, 39 per cent, and of those who previous to their illness had indoor positions but who after discharge had taken up out-door work, 42 per cent. Of 236 incipient cases discharged from our sanatorium, 82 per cent are alive, well and at work. Of 697 moderately advanced cases discharged in the last 12 years, 45 per cent are alive and at work. Of 179 far advanced cases, only 18 per cent are working. The problem of employment for the advanced cases is not simple. Part time for these cases, and work of not too laborious a nature, is important. The preaching of improved home and better living will have a most beneficial influence. The Home Hospital in New York City has shown what proper housing will do for many cases of tuberculosis.—*Employment of Persons in the Arrested Stage of Tuberculosis, James S. Ford, Med. Record, December 30, 1916.*

**Aftercare in Pulmonary Tuberculosis.**—Many of the ultimate failures encountered in the treatment of pulmonary tuberculosis are due to the lack of facilities for the proper aftercare of the patients following their discharge from sanatoriums. A patient may have been able to do a moderate amount of work while in the sanatorium where he received adequate nourishment. Then he is discharged and is forced at once to earn a living for himself and possibly also for a family. The strain of the increased work and the longer hours, coupled with an almost certainly inadequate food supply, is often enough to carry him down again. From such relapses the patients often pass into a state of chronic progressive disease, instead of becoming useful citizens. What is seriously needed is some means whereby such persons may return slowly to full working capacity, while receiving sufficient financial aid to eke out their earnings to a point sufficient to provide good food and favorable living conditions. Such a form of aid would cost less in the end than the present plan of letting these patients relapse and become public charges in a few months.—*Aftercare in Pulmonary Tuberculosis, P. C. Varrier-Jones, Lancet, September 30, 1916.*

**Tuberculosis and Life Insurance.**—Long before the clinician can detect tuberculosis there are often signs worthy of study. Slight underweight, recent loss of weight with dubious family history is suspicious. The young fellow, grown up rapidly "like a weed," is apt to die early of tuberculosis, particularly if he has shot up to 6 feet or over; very tall young men are border-line risks. Change of residence or occupations is ominous; find the real reason. Environment is a paramount factor. The intelligent young man, financially able to observe sanitary precautions and to employ competent medical skill, is obviously a safer risk than a poor, ignorant fellow, oblivious to danger and unable to protect himself from infection or to obtain relief when stricken. The family may not show tuberculosis, yet if one after another member has died early, before middle life, of disease usually not serious, you should be impressed

with this frailty; it forbodes lessened longevity for the applicant. We must watch for the earliest increase in pulse rate, in respiration; note a capricious appetite, any diminution in pulse pressure and, at times, find the so-called pre-tubercular albumin, Later, if the kidneys are involved, we find pus cells.—*Tuberculosis and Life Insurance, John L. Davis, quoted in Medical Insurance and Health Conservation, Dallas, Tex., November, 1916.*

**Prognosis in Tuberculosis.**—A study was made of 1,515 cases of tuberculosis with the object of determining what may reasonably be expected from intelligent care and treatment in various classes of tuberculous invalids, with the assumption to start with, that a patient who will spend at least a month (in most instances many months) in a sanatorium, will avail himself of every means of recovery within his reach, and with his sanatorium training will avoid, at least, the more dangerous pitfalls which beset the consumptive.

All the cases except seven were pulmonary; they were all under observation in Loomis Sanatorium for at least one month, the average being six to nine months, and were scattered over a period from 1896 to October 31, 1910. They were classified upon admission as follows: Incipient, 256; moderately advanced, 634; far advanced, 618; and seven with lesions elsewhere than in the lungs. A comparison of the odds for or against probability of life at the end of five years as compared with the general population is shown in the accompanying table.

A study of cases discharged from the sanatorium has shown that the most important single desideratum to be striven for by the patient is the conversion of an "open" lesion into a "closed" one. Not only is this the paramount sign of improvement, but it also gives the patient something definite to look for and it comes more easily than an apparent cure.—*Contribution to the Study of Prognosis in Tuberculosis, H. M. King (Loomis, N. Y.), Johns Hopkins Hosp. Bull., November, 1916.*

| | NUMBER IN EACH ONE THOUSAND ALIVE AT END OF FIVE YEARS | NUMBER IN EACH ONE THOUSAND DEAD AT END OF FIVE YEARS | ODDS FOR OR AGAINST THE PROBABILITY OF LIFE AT THE END OF FIVE YEARS |
|---|---|---|---|
| General population | 951 | 49 | 19.4 to 1 in favor. |
| Tuberculous patients by condition on admission: | | | |
| Incipient | 859 | 141 | 6.1 to 1 in favor. |
| Moderately advanced | 258 | 442 | 1.3 to 1 in favor. |
| Far advanced | 222 | 778 | 3.5 to 1 against. |
| Tuberculous patients by condition on discharge: | | | |
| Apparently cured | 919 | 81 | 11.3 to 1 in favor. |
| Arrested | 662 | 338 | 1.9 to 1 in favor. |
| Improved | 385 | 615 | 1.6 to 1 against. |
| Unimproved | 50 | 950 | 19.0 to 1 against. |
| Tuberculous patients: | | | |
| No bacilli demonstrable during residence | 874 | 126 | 6.9 to 1 in favor. |
| Sputum changing from bacillary to non-bacillary | 773 | 227 | 3.4 to 1 in favor. |
| Sputum bacillary on discharge | 287 | 713 | 2.5 to 1 against. |
| All classes of tuberculous patients combined | 473 | 527 | 1.1 to 1 against. |
| Patients discharged with disease quiescent but with bacillary sputum | 607 | 393 | 1.5 to 1 in favor. |

**Prevention of Tuberculosis.**—In spite of all we have learned about the tubercle bacillus, we are yet ignorant of the one essential factor, why and how it produces a tubercle. This and a large number of other pressing problems may be solved for us by the chemist, the physiologist, the surgeon or all combined. What we especially need are funds and facilities to provide the opportunity for research and research workers to take up these problems. The single factor of making the practical education of tuberculosis, from the standpoint of diagnosis, treatment, and social aspect, a demand of the prescribed courses for doctors and nurses in the institutions where they

are trained will do more in five years to reduce the morbidity and mortality from this disease than all the special institutions for its care that we have been at such pains to establish. How much of tuberculosis is closely bound up with our houses, schools, food, workshops, our means of transportation, our dusty streets, our wages, poverty, and with other diseases, cannot be answered as yet completely and finally. We know enough, however, to make these relations part of the education of our whole population. For this education we should make use of the three important sources: the schools, the pulpit, and the newspapers. The two outstanding demands in such a universal problem are uniformity and equable division of labor. One class must not be neglected while another class is helped; all States must be equally efficient; all races uniformly protected. We must avoid duplication of labor resulting from the separation of tuberculosis from other health and charitable efforts. There must be a unit of equipment for a unit of population. The management of these units is centered in a legally constituted governing body. For each 100,000 population there should be a hospital of 200 beds, a dispensary, and an open air school, 15 nurses, and about five doctors.—*The Etiology and Prevention of Tuberculosis from the Sociological Points of View, Wm. Chas. White, Amer. Jour. Med. Sciences, December, 1916.*

**Control of Tuberculosis.**—Since the success of a sanatorium depends in great measure upon the general medical profession, a plan has been evolved whereby sanatorium physicians are used in such manner as to obtain close coöperation between sanatorium and the public through the medium of the profession. The sanatorium physician visits the members of the medical profession to become acquainted, to learn their ideas regarding the institution, to inquire concerning cases of tuberculosis under treatment, the home conditions, number of children, etc., and to assist the home physician in persuading such cases to go to the sanatorium; and finally, to offer his services to the physician in assisting in the diagnosis of suspected cases. These facilities should be taken advantage of by the physicians. They should help to fill the sanatoria with cases already present in their communities and prevent the development of new cases by proper care of the old, by the examination and proper care of the children, and by the use of the sanatorium physicians for assistance and in doubtful cases.—*The Medical Profession in the Control of Tuberculosis, Robinson Bosworth, St. Paul Med. Jour., November, 1916.*

**Tuberculosis in an Alaska Village.**—The great prevalence of tuberculosis among the Alaska Eskimos is not to be wondered at by one who is familiar with the poor hygienic surroundings, the lack of ventilation, of fuel, of any system of sewage disposal, of clothing and of proper food. In one village, St. Michael, where there are two schools, one native and one white, it was found that of 26 native children 20 reacted to tuberculin and 18 had a temperature at some part of the day above 99°F. Three had bacilli in the sputum and six had the micrococcus tetragenus, out of 14 cases in which the sputum was examined. Eight children were examined from the "white school." Seven of these had positive von Pirquet and four had a temperature over 99°F. The sputum of these cases was not examined. Of eleven adults who asked to be examined for cough, and some for hemorrhage, all had tuberculosis.—*A Tuberculosis Survey of an Alaska Eskimo Village, H. Clay Michie, Med. Record October 14, 1916.*

**Legislation for Control of Tuberculosis.**—The Massachusetts Association of Boards of Health has submitted to the Massachusetts General Court two bills designed to supplement existing legislation. The first bill provides that whenever a tuberculous person is a source of danger to his family or the public, the local board of health may request the police or court to order his removal to an institution, the patient having the right to appeal to the Superior Court. The patient shall remain in the institution, subject to the rules, until discharged. He shall however, have, the right to apply for discharge to the local court with right of appeal to Superior Court, if discharge is not granted. Should the inmate of an institution fail to obey the rule or defy the officer in charge or act in such a way as to endanger the health or comfort of other inmates, the officer in charge may petition the Court to cause the removal of said inmate to any institution maintained by the State for the care of unruly and incorrigible consumptives. The patient who is able to pay for the cost of his care in the institutions mentioned shall be ordered by the magistrate to do so, failing which the officer requesting said removal may bring civil action to recover the amount stipulated in the magistrate's order. No action taken under this law shall be held to be a record of crime or misdemeanor.

The second bill provides for the care and treatment of wilfully careless and incorrigible tuberculous patients. It empowers the trustees of hospitals for consumptives to take land in fee by right of eminent domain or to purchase the same and to erect on such land

a hospital or hospitals for the custody, care and treatment of incorrigible and careless tuberculous patients.—*Editorial, Boston M. & S. J. February 22, 1917, clxxvi, no. 9.*

**Tuberculosis Statistics in New York City.** Below appear statistics relative to tuberculosis for the fourth quarter, 1916, and for comparison the corresponding quarter of 1916.

Of especial interest are the figures pertaining to the number of deaths and the death rate, both showing a notable reduction. There were approximately 300 fewer cases of the disease reported, and the number of patients under registration at the end of the quarter was over 2,000 less than at the corresponding time last year. Considering the year as a whole, the death rate was 1.50, the lowest in the history of this Department, and a considerable decline from 1.61, the figure for the year 1915. It is to be hoped that the intensive efforts directed toward the control of this disease will result in a still further reduction for the present year.

*Statistics for the fourth quarter of 1916, compared with those for the corresponding period of 1915*

| | | MANHATTAN | THE BRONX | BROOKLYN | QUEENS | RICHMOND | CITY |
|---|---|---|---|---|---|---|---|
| Population, revised | 1915 | 2,585,469 | 552,538 | 1,881,063 | 353,156 | 95,964 | 5,468,190 |
| | 1916 | 2,634,223 | 575,877 | 1,928,432 | 366,426 | 97,883 | 5,602,841 |
| New cases | 1915 | 2,676 | 405 | 1,264 | 281 | 47 | 4,673 |
| | 1916 | 2,413 | 388 | 1,305 | 234 | 43 | 4,383 |
| Total cases in register, December 31 | 1915 | 22,993 | 3,782 | 9,805 | 1,474 | 366 | 38,420 |
| | 1916 | 21,636 | 3,396 | 9,092 | 1,574 | 360 | 36,058 |
| Admitted to hospitals | 1915 | 3,527 | | | | | 3,527 |
| | 1916 | 3,322 | | | | | 3,322 |
| Examined for Admission to sanatorium | 1915 | 453 | | | | | 453 |
| | 1916 | 591 | | | | | 591 |
| Attendance at day camp | 1915 | 151 | | 93 | | | 244 |
| | 1916 | 135 | | 69 | | | 204 |
| New patients examined at clinic | 1915 | 2,197 | 580 | 1,509 | 249 | 26 | 4,561 |
| | 1916 | 1,742 | 452 | 1,222 | 204 | 33 | 3,653 |
| Total visits of patients | 1915 | 15,428 | 4,507 | 10,429 | 2,336 | 281 | 32,981 |
| | 1916 | 10,981 | 3,675 | 7,781 | 1,460 | 316 | 24,213 |
| Under sanitary supervision | 1915 | 796 | 160 | 1,319 | 18 | 29 | 2,322 |
| | 1916 | 709 | 162 | 1,195 | 5 | 22 | 2,093 |
| Renovations ordered | 1915 | | | 16 | | | 16 |
| | 1916 | | | | | | |
| Voluntary renovations | 1915 | 2,346 | 264 | 956 | 79 | 4 | 3,649 |
| | 1916 | 1,955 | 270 | 1,371 | 151 | 45 | 3,792 |
| Specimens of sputum examined | 1915 | 10,172 | 1,616 | 4,004 | 663 | 136 | 16,591 |
| | 1916 | 9,205 | 1,753 | 3,917 | 671 | 205 | 15,751 |
| Positive | 1915 | 1,787 | 292 | 984 | 171 | 32 | 3,266 |
| | 1916 | 2,038 | 305 | 1,004 | 138 | 55 | 3,540 |
| Deaths, pulmonary tuberculosis | 1915 | 1,032 | 238 | 625 | 124 | 39 | 2,058 |
| | 1916 | 994 | 202 | 628 | 138 | 38 | 2,000 |
| Death rate per 1000 population | 1915 | 1.58 | 1.71 | 1.32 | 1.39 | 1.61 | 1.49 |
| | 1916 | 1.50 | 1.39 | 1.29 | 1.50 | 1.54 | 1.42 |

*—Weekly Bull.—N. Y. City Health Dept., March 3, 1917.*

**The Incomplete Cure of the Consumptive.**—Conclusions of trained statisticians cannot be ignored, more especially when they are supported by the general if less precise, balance of clinical opinion, and therefore it must be taken as agreed that in so far as reduction of death rate is concerned, the treatment of consumption by open air and sanatorium methods has not fulfilled the promise of its earlier promoters. Since 1837 when registration was first attempted there has been a steady diminution in the death rate from consumption as a whole, although fluctuations have been noted at irregular periods. It does not appear that any striking change has occurred, if the new methods had achieved the success predicted for them.

Prof. Karl Pearson, writing in 1912 presented statistics to prove that the death rate from phthisis during the period 1847–1866 was already falling much more rapidly than the general death rate and that this proportion was still more noteworthy between 1866 and 1891, whereas during the last period, from 1891 to 1910, the most active period of the antituberculosis crusade the rate of fall, would appear to have been retarded. A similar conclusion with respect to mortality was arrived by the Messrs. Elderton and Perry in 1910.

Among the many influences that may be at work to maintain and foster the spread of tuberculosis, that of housing must always take a prominent part, such as overcrowding, insanitary houses, lack of pure water and milk, the latter two playing a less important rôle.

Evidence collected by Sir Shirley Murphy showed that the death rate from tuberculosis in London steadily increases with the proportion of the total population, living more than two in a room, in tenements containing less than five rooms. Although it obviously operates to spread the disease, overcrowding in itself must not be regarded as a cause of it, but plus where a source of infection already exists. In some districts attempts are being made to shake off this reproach, and to organize a system more in keeping with the dictates of common sense. Efforts are being made to supply shelters where infected individuals still able to work may spend their nights for an indefinite period in fresh air alone.—*Leading Article. Brit. M. J. January 6, 1917, no. 2923, 22.*

**Incomplete Cure of the Consumptive.**—In spite of the glowing promise held out by its promoters, the Insurance act, has not as yet succeeded in checking the progress of consumption. The statistics of county and other sanatoriums afford abundant evidence of the fact that cases in all stages have been under treatment and that beds which, from the economic point of view, should be strictly reserved for early cases have been occupied for prolonged periods by second and third stage cases.

The three cardinal defects of the present system are, the return of the consumptive to his overcrowded home, the occupying of beds in sanatoriums by unsuitable cases, and the total lack of any control over the main source of infection.

The restoration of the incipient consumptive to working capacity is essentially the concern of the municipalities and the State and not a matter of charity.

Turning to the third stage cases, the need for interference of the State or municipalities again becomes obvious. Segregation of such persons from the close intimacy of family life is an imperative necessity, if the hopes of eradication of tubercle are ever to be realized. Such segregation can be carried out by central authority.

Returns published by Insurance act authorities make it evident that more than half the number of cases recommended for sanatorium treatment cannot be accommodated.

Introduction of tuberculosis dispensaries has done something in this direction by providing local clearing houses where individual cases can be dealt with on the lines best suited to their needs, but their powers are very limited. They can only advise and have no power to insist.

Desire of individual freedom has been allowed to override the common welfare and it is time that the interests of the community should be more fully considered, even if it involves a certain amount of restraint upon the individual.—*Leading Article, Brit. M. J., January 13, 1917, no. 2924, 51.*

**Completed Cases of Tuberculosis.**—The number of cases which have terminated their connection with the U. S. Army General Hospital at Fort Bayard during the year 1915 numbered 446. Among these there were found the following complications: tuberculous laryngitis, 60; otitis media, 40; syphilis, 48; valvular heart disease, 2; fistula in ano, 9; tuberculous enteritis, 7; tuberculous spondylitis, 5; nephritis, 6; tuberculous epididymitis, 3; tuberculous peritonitis, 3; pneumothorax, 2; pyopneumothorax, 2; tuberculous hydrothorax, 2; tuberculous cystitis, 2; aortic aneurism, tuberculous prostatitis, and septic endocarditis, each, 1.

The result of treatment in completed cases of pulmonary tuberculosis was as follows:

Of 54 incipient cases: apparently cured,

3; arrested, 13; apparently arrested, 23; quiescent, 2; improved, 9; unimproved, 3.

175 moderately advanced: apparently cured, 9; arrested, 11; apparently arrested, 14; quiescent, 18; improved, 84; unimproved 33; died, 6.

216 far advanced cases: arrested, 1; quiescent, 4; improved, 81; unimproved, 87; died, 43. One case, acute miliary tuberculosis, died.

Fort Bayard is situated in the extreme southwestern part of New Mexico, at an altitude of 6,165 feet. The climate is rather cool and the usual vicissitudes of the seasons are experienced. The winters as a whole are relatively warm, dry and clear; while in summer the heat is tempered by the dryness of the air, with the resulting diathermancy. Clouds and rains are frequently present during what would otherwise be the hottest portion of the summer days. The peculiar excellence of the climate consists in the fact that it is one that avoids harmful extremes of temperature.—*Record of Completed Cases of Tuberculosis. Report of U. S. Army General Hospital, Fort Bayard, N. M., 1916.*

**Sanatorium Reports.**—In all reports issued by medical and lay authorities the statistical tables of results apparently achieved, hold a prominent place. But in the case of disease so chronic as tuberculosis such satistics are apt to be very misleading. This fact is frankly acknowledged in a full report for the information of the Insurance committee of the Burgh of Glasgow. Great pains have been taken to ascertain the present condition and whereabouts of all patients discharged from sanatorium treatment within the jurisdiction of the burgh during a period of two and a half years ending December 1914.

Very many patients who figured in the statistics of cases leaving the sanatoriums as "improved" or even as "disease arrested" were found to be dead. Taking capacity for work as the crucial test, it was found that as many as 70 per cent of the early cases could be included, but that no less than 19 per cent of such cases had died. The proportions of deaths in the later stages of the disease were correspondingly higher, but many of them have been previously recorded as having been benefited by treatment. A considerable number of persons with advanced disease were found to be still capable of remunerative work, and herein may be also traced a statistical fallacy. Many cases, classed as advanced, have a better expectation of life than others with small lesions. Prognosis depends more upon the virulence than upon the extent of the disease.—*Leading Article, Brit. M. J., February 10, 1917, no. 2928, 199.*

**Tuberculosis and Life Insurance.**—Some interesting data were obtained by the Medico-Actuarial investigators who studied the experience of twenty-three companies over a period of twenty-five years, involving 2,000,000 lives. In the table, 100 per cent represents the death rates experienced among all the standard lives during the period of observation. Where an applicant had an attack of blood spitting, with or without a distinct history of tuberculosis of the lungs, within five years of application, the deaths from tuberculosis of the lungs were fully five times the normal. In cases where there was a history of an attack of blood spitting between five and ten years prior to application, the death rate from tuberculosis of the lungs was about three times the normal, and in cases where there was one or more attacks, the last occuring more than ten years prior to application, the death rate from the disease was nearly twice the normal. There are indications that the mortality is relatively much higher at the younger than at the older age at entry. An investigation made in 1913 into the mortality of 3,000 patients discharged from an Adirondack Sanatorium, covering the period from 1885 to 1911, showed that the mortality among those discharged apparently cured was twice the normal. Among those with a history of tuberculosis in the family, the high death rate is found among those who are under weight and between the ages of 15 and 20 at entry. In underweights above 30 at entry the rate is normal, and remains so even between the ages of 15 and 30 when the weight is from 25 to 45 per cent above the average. There were 216 cases with a history of an attack of glandular tuberculosis within ten years of application. The number of actual deaths was 16 as compared to the number of expected deaths, 8.93. Of 370 cases giving a history of a gland tuberculosis more than ten years prior to application, 25 died compared to 22.21 expected deaths. As regards tuberculosis of bone and joints, there were 44 actual as against 23.14 expected deaths among those with a history of an attack within ten years of application; while among those with a previous attack at least ten years prior, there were 90 deaths against 75.17 expected deaths.—*From a paper read at Amer. Sanatorium Assoc. Meeting, December 6, 1916. Augustus S. Knight, Medical Director, Metropolitan Life Insurance Company.*

**Tuberculosis and Life Insurance.**—As a criterion for the acceptance or rejection

of risks in life insurance, the subcutaneous tuberculin test is of greatest importance. Applicants, who on account of family history, or known exposure to tuberculosis, would be considered doubtful risks or ineligible for insurance, should be submitted to the subcutaneous test. Those who do not react and are otherwise eligible should be accepted at the ordinary terms or at special rates; those who react positively should return in six months or a year for a re-examination. The data thus collected can serve later as basis for judging future applicants.—*The Tuberculosis Problem in Life Insurance, G T. Brown, Med. Insur. and Health Conserve., February, 1917.*

**Tuberculosis and the War.**—Camp and trench life has not been productive of more breakdowns than would have occurred in civilian employment. It is amazing that in a citizen army running up to millions the incidence of breakdown from tuberculosis all told should have been only in the lower thousands. A rough calculation of breakdown from the same cause among men of military age in industrial occupations would give a vastly higher total, and we reiterate the hope we expressed a year ago that the accustoming of the industrial population to a habit of outdoor life may be a permanent health asset in the future. Light also is dawning on the general question of the treatment of tuberculosis in civil life.

The chronic case is not a responsive occupant of sanitorium beds, and the results do not justify his preponderence there. Doctor D. Dunbar reports that 5 per cent of the inmates of the Aysgarth Sanatorium are permanently benefited, and it is becoming clearer that sanatorium treatment in the strict sense is not even necessarily the best treatment for the chronic consumptive. Belief is steadily gaining ground in the increasing value of dispensary treatment at the hands of an expert tuberculosis officer and domiciliary treatment by the panel doctor, assisted by a specialist, where available. The Local Government Board evidently had this in mind in the recent issue of the order for domiciliary treatment which came into force at the beginning of the present year.—*Leading Article, The Lancet, February 17, 1917, cxcii, no. 4887, 268.*

**Conjugal Phthisis.**—The simultaneous or consecutive occurrence of phthisis in husband and wife is extremely rare, about 2.9 per cent; and even then it is a mere coincidence. This, however, cannot be taken as proof against the transmissibility of tuberculosis from the sick to the healthy. The rarity is explained by the presence of immunity conferred by a previous tuberculous infection. Children, however, especially infants, are infected with some form of tuberculosis in 84 per cent of cases, and a large proportion succumb.—*The Rarity of Conjugal Phthisis, M. Fishberg Am. J., M. Sc. March 1917, cliii, no. 3.*

**Trauma and Tuberculosis.**—Orth has had occasion to testify in four additional cases in which the accident insurance companies were questioning the connection between a trauma and following tuberculous disease or aggravation. The details of these (ninth to twelfth) cases are given in full. In three of the cases he testified to the effect that the trauma had no direct connection with the tuberculosis but, in the fourth, that there could be no doubt that the trauma had been responsible for the fatal hemoptysis that had followed.—*Trauma und Tuberkulose,' J. Orth, Zeitschr. f. Tuberk., 1916, xxvi, no. 4.*

**The Delayed Tuberculous Infection.**—As a contribution to the jubilee of the late Professor Metchnikoff, of the Pasteur Institute at Paris, Professor Delépine, Director of the Public Health Laboratory, University of Manchester, sent an interesting paper (Annales de l'Institute Pasteur, Paris, 1916. xxx, 600), throwing light on the genesis of latent or delayed forms of tuberculous infection in some instances. He argues that tubercle bacilli of various strains or degrees of virulence are so commonly encountered in daily life that every one of us must be exposed frequently to the danger of infection thereby, and points out that his argument has been used to prove the view that the resisting power of the individual is the main factor determining whether infection takes place or not. This paradox, he holds, takes insufficient account of the normal variability in the pathogenic powers of any given sample of the tubercle bacillus. To prove the correctness of his own view, he quotes certain experiments he has made on guinea-pigs. These experiments consisted of the inoculation of the animals with human tubercle bacilli of normal virulence but first heated in the course of a few minutes to 78°C. or 92°C. in order to reduce their pathogenicity. Experiment showed that these heated tubercle bacilli produced but slight local lesions at the end of eleven weeks; whereas before being heated they gave rise to local ulceration in a fortnight. But further observation of the guinea-pigs inoculated with the heated bacilli proved that these microbes recovered their normal pathogenicity when conveyed—no doubt by phagocytes—to distant parts of the experi-

mental animals' bodies. The recuperation of the pathogenic powers became more marked as the distance from the seat of inoculation increased; for, while the local lesions remained insignificant, those of distant organs became practically as extensive as those found in animals inoculated with the unheated tubercle bacilli. The period of latency in these experiments amounted to two or three weeks, and Professor Delépine argues that it throws light on a most important aspect of the processes of infection that has, perhaps, been neglected in the past. He also quotes experiments to show that tubercle bacilli can retain some of their pathogenicity for as long as five hundred days if kept in the dark in milk at low temperature—below 6°C. But after being kept thus four and one-half years these bacilli were no longer pathogenic to guinea-pigs.—*Leading Article, Brit. M. J. March 3, 1917, no. 2931, 304.*

**What is Being Done in Southwestern France to Combat Tuberculosis.**—This entire number is devoted to descriptions of the various sanatoriums and organizations in the Gironde department, aiming to arrest the spread of tuberculosis. Arnozan remarks that among the thousand other problems brought by the war and pressing for solution, the question of what to do with the tuberculous soldiers soon became one of the most important. All provisions made for isolation and care soon proved inadequate for the throngs flocking to them for a three months' course of treatment and training. Tuberculous soldiers are so numerous, at present, especially in the cities, that their participation in social life is indispensable. To isolate them all suddenly would be to dry up an important source of the economic life of the country. Outside of the acute phases of the disease, the earning capacity of the tuberculous merchant workman, or farmhand may not suffer materially for years and years. But if the tuberculous soldiers return to indoor and factory occupations, their doom is sealed, while outdoor occupations might result in a clinical cure. Many tuberculous soldiers long to take up farm life, but they have no means nor training for this. The state should make it possible for them to return to the land. It would be cheaper in the long run than merely palliative measures, such as sanatoriums and hospitals. A central office should be organized to study all the outdoor occupations open to the tuberculous, and also an employment bureau to place the men as farmhands, woodsmen, charcoal burners, surveyors, etc. But, better than all, is the plan to set up each tuberculous soldier on a small farm. A colony of such farms at a very low rental would solve the problems of restoring health self-support and companionship. The house should be planned on the sanatorium model, with separate sleeping room for the tuberculous member of the family. Charitable societies have an ample field here. By this means the country would get the benefit of the strength still left in its tuberculous soldiers and their lives would be lengthened. Left to themselves, they will be apt to drift into crowded factories and sleep in close crowded rooms, sealing their own doom and infecting others.—*Les institutions antituberculeuses, avant la guerre. Les oeuvres militaires et les projects civils depuis la guerre. Arnozan, J. de Med. de Bordeaux, March 1917, lxxxviii, no. 3, 41-60.*

**Fallacy of Fallacies About Tuberculosis.**—Dr. Fishberg dismisses many a live medical problem by the convenient term "fallacy." His statement that "over 90 per cent of human beings in large cities have been infected during their life time" and that "it is difficult to find a person who does not react to tuberculin, or in whom active, latent, or healed tuberculous lessions cannot be found when a careful autopsy is made" is not exactly correct. In this country autopsies show evidence of old tuberculous lesions in 60 to 75 per cent. Only 60 to 75 per cent of children react to tuberculin, not "almost all children," and in a certain proportion of postitive cases the children may possess an inherent or acquired sensitiveness to tuberculin without having been infected. Such sensitiveness may be the result of infection with certain acid fast bacilli belonging to the group, but which do not produce a true tuberculosis. We know that the serum of normal persons who never have had typhoid fever may give a positive Widal reaction in certain dilutions. There are, then, at least 25 per cent of people who are free from tuberculous infection and in danger of such infection when exposed to a sufficient number of implantations. Tuberculosis is not as benign as Dr. Fishberg, perhaps unintentionally, would have us believe. There are 200,000 graves filled annually with victims of this disease, and we know that when the tubercle bacillus has made an appreciable inroad into the tissues, the patient has a mighty hard time to manage to live. Furthermore, granting for the sake of argument that nearly all adults have acquired the infection, does that mean that we are immune? We are not at all sure that reinfection is impossible Tonsillitis, influenza, pneumonia and many other diseases do not confer any lasting immunity. Generally, infections characterized by bacteriemia confer a life long immunity, while in those in which the bacteria are localized and the toxemia is the

underlying factor, the immunity is of short duration. Tuberculosis is a toxemic infection. The warnings given to consumptives that they must not expectorate indiscriminately, because they are likely to infect others, and may reinfect themselves, and thus acquire lesions in hitherto unaffected parts, is quite timely. Tuberculosis spreads by extension, probably through the lymphatics; and so affects successive areas of lung. The larynx, at times the pharynx; and the intestines become involved as result of contact with germ-laden sputum. Now, if a consumptive can reinfect himself, why can he not reinfect others? After all, the incidence of infection, all other things being equal is a matter of dosage. A person may resist a certain number of tubercle bacilli and succumb to a larger number. The proper care of the consumptive's sputum should be advocated for still another reason, viz: to prevent the dissemination of the pyogenic cocci which give rise to the severe septic conditions from which the advanced consumptive suffers and from which the patient with early tuberculosis is relatively free. Dr. Fishberg accounts for the rarity of infection among doctors and nurses as well as for conjugal phthisis by the fact that they are immune by virtue of a preexisting infection. Does immunity also explain their freedom from tuberculous disease? What became of the immunity of the afflicted? The moist sputum, with which doctors in institutions come in contact, is the least prolific source of aerogenous infection. An early diagnosis is essential, because proper treatment before metabolism is too much disturbed will yield better chances of recovery. Deny this, and you deny the utility of early rational treatment in nephritis, diabetes, arteriosclerosis, etc. The rational treatment of tuberculosis is such as will increase the natural resistance of the patient, if the has any. The most important part in the treatment is the regulation of rest and exercise. The hospital takes care of the advanced and incurable consumptive for humane reasons, at the same time segregating him and preventing infection of others (children). The sanatorium places the curable consumptive in the best possible position to get well. In the sanatorium, also, advanced work is carried on to the ultimate benefit of mankind.—*The Fallacy of Fallacies About Tuberculosis A Robin. A Criticism of Dr. Fishberg's Paper in the December 2, 1916 number. N. Y. M. J. December 30, 1916, civ, no. 52.*

**Infectiousness of Tuberculosis.**—A fair percentage of people possess a natural immunity against certain diseases. It is computed that seventy per cent. of children are immune against diptheria. With measles and tuberculosis, however, there are probably not two per cent of children who by their inherent immunity can escape these infections.

To take advantage of all the knowledge we have gained in regard to the infectiousness of tuberculosis, we must demand: that all consumptives should shield their mouths when coughing, especially in the presence of children, and that their expectoration shall be properly destroyed: that all young children, especially infants, be removed from contact with the spitting consumptive; that the general public be reassured that there can be no danger to them from ordinary contact with the consumptive; that school children in all communities should have the services of school physicians whose duty should be to see that children who are below par and who would seem to be candidates for active disease should be cared for and placed in open air pavilions until such dangers are passed; that in all cities open air pavilions or so called preventoriums be built where such children can be properly cared for.—*The Infectiousness of Tuberculosis, G. B. Webb, Southwestern Medicine, February, 1917, I. no. 2.*

**"Open" and "Closed" Tuberculosis.**—Effler protests against the classification of cases of tuberculosis merely by the presence or absence of tubercle bacilli in the sputum. Many regard the case as contagious or noncontagious solely from the sputum findings on one or two or more examinations. Cases are common in which, if the examinations are repeated often enough, bacilli finally appear in the sputum. He cites some cases in which the examinations repeated several times in the course of two or three months, gave positive findings after two or three negative examinations. Gerhard used to tell of a case in which only the fifty-ninth examination gave positive findings. The prevalence of tuberculosis in cadavers suggests almost that there must be still some other mode of contagion than from the sputum alone. It is incredible that this enormous number of infections comes from those alone who have tubercle bacilli in their sputum. In short, any tuberculous person with sputum must be regarded as contagious, whether tubercle bacilli can be found at the moment or not. As for that, the absence of sputum is only a transient phase, which at any moment may take an unfavorable turn. Tuberculosis must be regarded not as a condit[illegible] but as a living process, and be manag[illegible] accordingly.—*Offene und geschlossene Tuberculose, Effler, Zeitschr. f. Tuberk., December 1916, xxvi, no. 6.*

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* "The Choice of Tuberculins," by Benjamin White, Otisville, N. Y., Department of Health, City of New York. Read at the annual meeting of the Medical Society of the State of New York, at Saratoga Springs, May 18, 1916.

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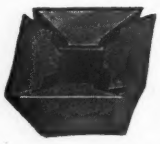

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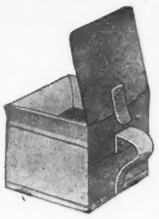

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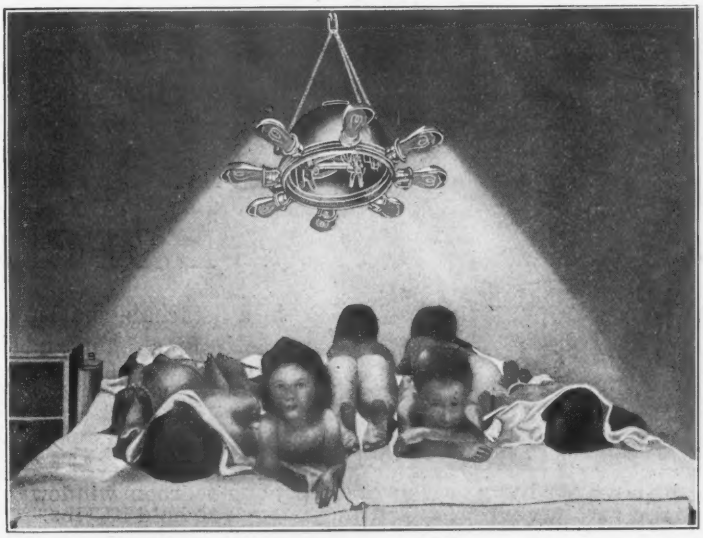

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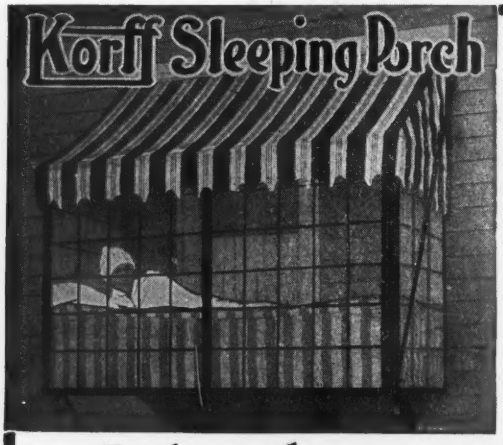


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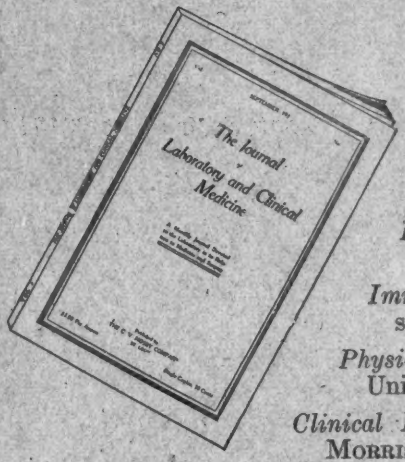


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